NAS8-36300
CR-196565

CSD 5597-93-2

BSM DELTA QUALIFICATION 2 FINAL REPORT

Volume III, Book 1

11 November 1994

(NASA-CR-196565) BSA DELTA QUALIFICATION 2, VOLUME 3, BOOK 1 Final Report (United Technologies Corp.) 424 p

N95-24845

Unclas

G3/20 0044774

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

P.O. Box 49028
San Jose, California 95161-9028

FOREWORD

This report, presented in three volumes, provides the results of a two-motor Delta Qualification 2 program conducted in 1993 to certify the following enhancements for incorporation into Booster Separation Motor (BSM) flight hardware:

- Vulcanized-in-place nozzle aft closure insulation
- New iso-static ATJ bulk graphite throat insert material
- Adhesive EA 9394 for bonding the nozzle throat, igniter grain rod/centering insert/igniter case
- Deletion of the igniter adapter insulator ring
- Deletion of the igniter adapter/igniter case interface RTV
- Deletion of Loctite from igniter retainer plate threads.

The enhancements above directly resulted from (1) the BSM Total Quality Management (TQM) Team initiatives to enhance the BSM producibility, and (2) the necessity to qualify new throat insert and adhesive systems to replace existing materials that will not be available.

Testing was completed at both the component and motor levels. Component testing was accomplished to screen candidate materials (e.g., throat materials, adhesive systems) and to optimize processes (e.g., aft closure insulator vulcanization approach) prior to their incorporation into the test motors. Motor testing — consisting of two motors, randomly selected by USBI's on-site quality personnel from production lot AAY, which were modified to accept the enhancements — were completed to provide the final qualification of the enhancements for incorporation into flight hardware.

This report addresses the motor level test results, with summary discussions of the component level testing where appropriate. Volume I discusses the results obtained from the Delta Qualification 2 testing. Volume II details the environmental testing (vibration and shock) conducted at Marshall Space Flight Center (MSFC) to which the motors were subjected prior to static testing. Volume III provides various supporting documentation to Volumes I and II, including the analyses and plans that governed the testing of the two Delta Qualification units.

Appendix A

THERMAL CYCLING PLANNING/ DATA ACCEPTANCE RECORDS

BSM MOTOR S/N 1000734

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

APPROVAL NO:	CHANGE SHEET CONTROL NO. LOG PCS 040217, 4834, 040223, 41841	DAR REV: BASIC PICKLIST REV: CSMS	PAGE 1 OF 6
TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	MFG. RELEASE PLNG 8/27/93	WORK ORDER RELEASE #: 5597-986-0006	REL #: MFGA 96534
PART NO: B12000-14-01-501 / REV: *1 / ECOs: NONE	Q.E. 8/27/93 ENGR 8/27/93 USBI 8/27/93	QTY: 1 / S/N: 1000734	MAT REV: BASIC
		NEXT ASSY: N/A	

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
0010-00-0	C0010T02	TRANSPORT PARTS/MATERIALS Production Control arrange transport of parts(s)/material(s) on Picklist to Station 1330 per MHC 2550.			
0020-00-0	T1330T09	TEMPERATURE CYCLING Perform Temperature Cycling in accordance with Operation 1 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 9-3-93	9-3-93	USBI 9-3-93
0030-00-0	C0010T02	TRANSPORT Production Control arrange transport of the Rocket Motor to Bldg. 0485 per MHC 2550.			
0040-00-0	P0485A61	SHIPPING CONTAINER Perform Shipping Container Operation in accordance with Operation 2 of Process Instruction 07.9.007, (Rev. Ø).	P 141 CS 9/3/93		
0050-00-0	P0485A61	PACKAGE ROCKET MOTOR Perform Rocket Motor Packaging Operation in accordance with Operation 3 of Process Instruction 07.9.007, (Rev. Ø).	9-3-93		
0060-00-0	P0485A61	PALLETIZING Palletize motors and prepare for shipment in accordance with Operation 4 of Process Instruction 07.9.007, (Rev. Ø).	798 CSD 9-3-93		
0070-00-0	Q0485P99	Q.C. REVIEW Q.C. review documentation for completeness.		115 CSD 9-8-93	

OFFICIAL COPY

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)		PAGE 2 OF 6	
PART NO: B12000-14-01-501	REL. #: MFGA 96534	MAT REV: BASIC	

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
0080-00-0	P0485A61	DOMESTIC SHIPMENT ADDRESS Perform domestic shipment address operation in accordance with Operation 5 of Process Instruction 07.9.007, (Rev. Ø).	P 141 CS 9/3/93		
0090-00-0	Q0485P99	USBI VERIFY USBI verify shipping documents for USBI Q.A.R. source release. Government review shipping documents		116 C80 9/3/93	USBI BPO 408 9/3/93 GOV'T 9/3/93
		NOTE MSC activities.			
0100-00-0 0165-00-0	C0010T02	TRANSPORT PARTS/MATERIALS Production Control arrange transport of part(s)/material(s) from Receiving/Inspection to Station 0485 per MHC 2550.			
~~0110-00-0~~	~~P0485A61~~	~~NOTIFY X-RAY~~ (PCS41834) ~~Ensure that the High Energy X-ray (HEX) personnel at ST-9 are ready to radiographically inspect the Rocket Motor. Do not proceed further until they have indicated that they are ready.~~			
~~0120-00-0~~	~~C0010T02~~	~~TRANSPORT~~ (PCS 41834) ~~Transport the Motor to HEX (ST-9) per MHC 2550.~~			
~~0130-00-0~~	~~T1319T07~~	~~CHECK~~ (PCS41834) ~~Check the insulation-wrapped Rocket Motor for static charge per Appendix 1 of Process Instruction 07.9.007, (Rev. Ø).~~			

SEE ATTACHED PAGES 3 OF 3 PCS 040217

2

TECHNOLOGIES
CHEMICAL
SYSTEMS

293 CSD

OCT 0 7 1993

MANUFACTURING ACCEPTANCE TRAVELER

PCS 040217 PG 2 of 5

CHANGE SHEET CONTROL NO. LOG				DAR REV. Basic	PICKLIST REV. Basic		PAGE 24 OF 36	
TITLE: BSM ENVIRONMENTAL ROCKET MOTOR UNPACKAGE (AFT)			MFG. RELEASE	WORK ORDER RELEASE NO.	REL NO. MFGA 96534			
PART NO. B12000-14-01-501	REV. 1	ECO's NONE	PLNG. Q.E. [illegible] 4-7-88 ENGR [illegible] USBI [illegible]	QTY.	SERIAL NO.		MAT REV. BASIC	
				NEXT ASSY-END ITEM N/A				
OPER.	GROUP	STA.	OPERATIONS INSTRUCTIONS AFTRD [illegible] 4-12-88	S/U HRS	RUN HRS	OPS STP-DTE	Q.C. STP-DTE	

Special Considerations

0105-00-0 All operations directed by this MAT shall be performed within the scope of the CSD Safety Manual.

3

Verify all hoisting/lifing devices being used are within expiration dates.

Production Control arrange transportation of parts/materials on Picklist to Station 485.

Q.C. inspect visually for damage to shipping container. Make notations on Recap Sheet Complete on DAR Item PD001.
USBI VISUALLY INSPECT

ORIGINAL PAGE IS OF POOR QUALITY

293 CSD

OCT 0 7 1993

WARNING

THE ROCKET MOTOR SHALL BE GROUNDED AT ALL TIMES TO PREVENT ACCUMULATION OF STATIC CHARGES. TO PREVENT INADEQUATE SRM (SOLID ROCKET MOTOR) GROUNDING AND THE POSSIBILITY OF INADVERTENT IGNITION, ENSURE THAT THE ATTACHMENT CLIPS ON GROUNDING CABLE AND ATTACHMENT POINTS ARE CLEAN AND FREE FROM PAINT AND OTHER FOREIGN MATERIAL. WHEN WEIGHING MOTORS GROUND CABLES MAY BE REMOVED MOMENTARILY TO READ

TECHNOLOGIES
CHEMICAL
SYSTEMS

293 CSO
OCT 07 1993

MANUFACTURING ACCEPTANCE TRAVELER

PCS 040217 PG 3 OF 5

TITLE: BSM ENVIRONMENTAL ROCKET MOTOR UNPACKAGE (AFT)		PAGE 28 OF 36
PART NO. B12000-14-01-501	REL NO. MFGA 96534	MAT REV. BASIC

OPER.	GROUP	STA.	OPERATIONS INSTRUCTIONS	S/U HRS	RUN HRS	OPS STP-DTE	Q.C. STP-DTE

Unpack motor assembly from shipping container per the following:

293 CSO
OCT 07 1993

A) Remove wire and lead seal from lockring. ~~SEE COMMENT SHEET, ITEM #~~ 2

P 141 CS
OCT 07 1993

B) Remove lockring by removing bolt and nut. ~~SEE COMMENT SHEET, ITEM #~~

293 CSO

C) Remove container lid and cushion insert.

OCT 07 1993

D) Remove desicant from container for regeneration.

E) Loose tie-rod nuts and remove top bearing plates.

F) Remove motor grounding strap from motor handling hole. Attach a station ground strap to the motor.

WARNING

ALL OVERHEAD CRANE/HOIST OPERATIONS REQUIRE THE USE OF HARD HATS BY CRANE/HOIST OPERATORS AND ALL PERSONNEL INVOLVED IN HOISTING OPERATIONS [illegible]

Pick up the motor assembly and [illegible] shipping container, nozzle end up [illegible] attached to the case aft flange [illegible]

P 141 CS
OCT 07 1993

ORIGINAL PAGE IS
OF POOR QUALITY

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

293 CSO

MANUFACTURING ACCEPTANCE TRAVELER

OCT 0 7 1993

PCS 040217 PG 4 OF 5

TITLE: BSM ENVIRONMENTAL ROCKET MOTOR UNPACKAGE (AFT)		PAGE 32 OF 36
PART NO. B12000-14-01-501	REL NO. MFGA 96534	MAT REV. BASIC

OPER.	GROUP	STA.	OPERATIONS INSTRUCTIONS	S/U HRS	RUN HRS	OPS STP-DTE	Q.C. STP-DTE
			Cross check the Serial Numbers recorded on Container Content Identification Tag and Motor. Verify that Serial Numbers are identical. RECORD ON DAR ITEM PD002. Q.C. VERIFY.			P 141 CS OCT 0 7 1993	
			REMOVE WEATHER SEAL. REMOVE GREASE FROM INSIDE OF EXIT CONE.				
			Q.C. Visually inspect motors for any signs of physical damage. Record any notations on Recap Sheet, also Record on DAR Item PD003. AFQC Witness. (This step may be done out of sequence). 4581 WITNESS.				293 CSO OCT 0 7 1993
			Cover Motor Case with Kraft paper for protection if it is not corked. N/A if not applicable.			P 141 CS	
			RE-GREASE INSIDE OF EXIT CONE AND INSTALL RUBBER THROAT PLUG.			OCT 0 7 1993	
			Place Motor Assembly in cradle supports on Work Table. Attach ground strap.			P 141 CS OCT 0 7 1993	
			Q.C. review documentation for completeness and Apply Accept Tag.				293 CSO 10-12-9?
			Production Control forward completed planning package to Data Acceptance Center.				

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)		PAGE 3 OF 6
PART NO: B12000-14-01-501	REL. #: MFGA 96534	MAT REV: BASIC

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
~~0140-00-0~~	~~T1319T07~~	~~REMOVE WRAPPING~~ (PCS41834) ~~When ready for radiographic inspection, slowly remove the wrapping from the Rocket Motor. Check again for static charge per Appendix 1 of Process Instruction 07.9.007, (Rev. Ø).~~			
0150-00-0	Q1319Q99	VISUAL INSPECTTION Perform visual inspection and alcohol wipe (PSC 41834) of Rocket Motor. Visual Inspection shall include an examination for surface corrosion. Reference operation 6 of Process Instruction 07.9.007, (Rev. Ø)		260 CSD 10-12-93	
0155-00-0 0160-00-0	Q1319Q99	RADIOGRAPHIC INSPECTION (PCS 040223) Perform radiographic inspection of Rocket Motor. X-RAY TO WORK INSTRUCTION 60.12.9-217. Attach radiographic inspection report to this Job Release Package. Reference Operation 6 of Process Instruction 07.9.007, (Rev. Ø).		10-13-93	
0165-00-0 0170-00-0	C0010T01	Transport Parts/Materials. Production control arrange transport of Parts/Materials on Picklist to Station 405 per MHC 2550. (PCS 41834) TRANSPORT PARTS/MATERIALS Production Control arrange transport of part(s)/material(s) on Picklist to Station 1330 per MHC 2550.			
0180-00-0	T1330T09	PREPARE MOTOR Prepare and obtain pre-test measurements in accordance with Operation 7 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 11-4-93		
0190-00-0	T1330T09	CONDITION MOTOR Temperature condition motor in accordance with Operation 8 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 11-4-93		
0200-00-0	T1310T01	PREPARE FOR TEST Prepare for test in accordance with Operation 9 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 11-4-93		
0155-00-0 (PCS 41834) 0167-00-0		Transport Parts/Materials. Production control arrange transport of Parts/Materials on Picklist to Station 1319 per MHC 2550. (PCS 41834) Complete OP 6, OF PI 07.9.007.	141 C S		

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)

PART NO: B12000-14-01-501 | REL. #: MFGA 96534

MAT REV: BASIC

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
0210-00-0	T1310T01	**COMBINED SYSTEMS TEST** Conduct Combined Systems Test in accordance with Operation 10 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 11-4-93		
0220-00-0	T1310T01	**STATIC TEST** Conduct Static Test Firing in accordance with Operation 11 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 11-4-93		
0230-00-0	T1310T01	**Q.C. REVIEW** Q.C. review the "quick look" pressure and thrust plots to verify data recorded. Annotate motor serial number, planning release number and conditioning temperature on the plots. Attach plots to the MAT planning package.	23 CSD 11-4-93	105 11-4-93	USBI 11-4-93
0240-00-0	T1313T04	**PERFORM POST-TEST** Perform post-test activities in accordance with Operation 12 of Process Instruction 07.9.007, (Rev. Ø).	186 11/5/93		
0250-00-0	T1310T01	**COPY DATA SHEET** Area Supervisor forward copy of the completed Data Sheet to the Test Engineer. (This operation may be performed at any convenient time after Operation 0280.)			
0260-00-0	Q1310Q99	**Q.C. REVIEW** Quality Control review documentation for completeness, data entries and open items.		105 11-5-93	
0270-00-0	C0010T02	**TRANSPORT MOTOR** Production Control arrange for transportation of motor to Building 0485 per MHC 2550.			

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)

PART NO: B12000-14-01-501

REL. #: MFGA 96534

MAT REV: BASIC

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
0280-00-0	C0010T02	FORWARD PLANNING Production Control forward planning package to Bldg. 0485.			
0290-00-0	P0485A61	DISASSEMBLY OF IGNITER FROM MOTOR Disassemble Igniter from Motor Case in accordance with Operation 13 of Process Instruction 07.9.007, (Rev. Ø).	P 141 CS 11-9-93		
0300-00-0	P0485A61	DISASSEMBLY OF NOZZLE FROM MOTOR Disassemble Nozzle from motor case in accordance with Operation 14 of Process Instruction 07.9.007, (Rev. Ø).	11-9-93		
0310-00-0	P0485A61	INSPECTION PLAN Engineering complete inspection plan. Engineering fill out attached data sheets.	ENGR		USBI
0320-00-0	P0485A61	TEST REPORT Engineering complete test report. USBI verify.	ENGR		USBI
0330-00-0	Q0485P99	Q.C. REVIEW AND GOV'T FINAL REVIEW Q.C. and Government review documentation for completeness and data entries.			GOV'T
0340-00-0	Q0485P99	FORWARD PLANNING Quality Control notify Production Control when planning is available for pick up.			

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)					
PART NO: B12000-14-01-501	REL. #: MFGA 96534		PAGE 6 OF 6		
			MAT REV: BASIC		
OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS	Q.C.	CUST
			STP-DT	STP-DT	STP-DT
0350-00-0	C0010T50	FORWARD PLANNING Production Control forward completed planning to the Data Acceptance Center.			

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	Q.E. 8/20/93 PSE 8/20/93 USBI 8/25/93	REL. #: MFGA 96534	PAGE 1 OF 18
		PART #: B12000-14-01-501	DAR REV: BASIC

ITEM / CAT / ZONE / METHODS / CODE / SOURCE — INSPECTION INSTRUCTIONS	DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	FINAL ACCEPTANCE OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
D001 III --- VIS REC C1 INSPECT SETUP.	---	---	ACCEPTABLE		105 8-27-93	USBI BPC 408 8-27-93
D002 III - VIS REC C1 TEMPERATURE STABILIZED.	130°F	136°F	CYCLE #1: BEGIN TIME: 0835 BEGIN DATE: 8-28-93	8-28-93	13 CSD 8-28-93	
D003 III - VIS REC C1 COMPLETION OF CYCLE #1			CYCLE #1: END TIME: 0905 END DATE: 8-29-93	8-29-93		
CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE.			(SEE COMMENT SHEET WHEN CHECKED) ☒			
EXPOSURE TO 133 ± 3°F.	24 HRS	---	TOTAL: 24 HRS 28min ~~[illegible]~~ HRS	23 CSD 9/29/93	SEE COMMENT SHT, #1	
D004 III - VIS REC C1 TEMPERATURE STABILIZED. GOV'T VERIFY (PCS 040223)	-16°F	-10°F	CYCLE #1: BEGIN TIME: 0950 BEGIN DATE: 8-29-93	8-29-93	8-29-93	GOV'T 10-14-93

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	FINAL ACCEPTANCE OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
D005	III	-	VIS	REC	C1	24 HRS	---	CYCLE #1 END TIME: 1025 END DATE: 8-30-93 (SEE COMMENT SHEET WHEN CHECKED) ☒ TOTAL: 24 HRS - ~~05 min~~ HRS 23 CSD 8/30/93 see Comment sht. #2	230 CSD 8-30-93		
COMPLETION OF CYCLE #1. CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE. EXPOSURE TO -13 ± 3°F.											
D006	III	-	VIS	REC	C1	130°F	136°F	CYCLE #2: BEGIN TIME: 1030 BEGIN DATE: 8-30-93	230 CSD 8-30-93	105 CSD 8-30-93	
TEMPERATURE STABILIZED.											
D007	III	-	VIS	REC	C1	24 HRS	---	CYCLE #2: END TIME: 1050 END DATE: 8-31-93 (SEE COMMENT SHEET WHEN CHECKED) ☐ TOTAL: 24 Hours 20 min HRS	8-31-93		
COMPLETION OF CYCLE #2 CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE. EXPOSURE TO 133 ± 3°F.											

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 3 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	FINAL ACCEPTANCE OPER STP-DT	FINAL ACCEPTANCE QUALITY STP-DT	FINAL ACCEPTANCE CUST/GOV STP-DT
D008	III	-	VIS	REC	C1						
TEMPERATURE STABILIZED. See common sht. #3						-16°F	-10°F	CYCLE #2: BEGIN TIME: 1110 BEGIN DATE: 8-31-93	8-31-93	105 8-31-93	
D009	III	-	VIS	REC	C1						
COMPLETION OF CYCLE #2.								CYCLE #2 END TIME: 1125 END DATE: 9-1-93 (SEE COMMENT SHEET WHEN CHECKED) ☐	9-1-93		
CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE. EXPOSURE TO -13± 3°F.						24 HRS	---	TOTAL: 24 HRS 15 min HRS			
D010	III	-	VIS	REC	C1						
TEMPERATURE STABILIZED.						130°F	136°F	CYCLE #3: BEGIN TIME: 1130 BEGIN DATE: 9-1-93	9-1-93	105 9-1-93	

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 4 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
D011	III	-	VIS	REC	C1						
COMPLETION OF CYCLE #3 CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE. EXPOSURE TO 133 ± 3°F.						24 HRS	---	CYCLE #3: END TIME: 1145 END DATE: 9-2-93 (SEE COMMENT SHEET WHEN CHECKED) ☐ TOTAL: 24 HRS 15 min HRS	☐ 9-2-93		
D012	III	-	VIS•	REC	C1						
TEMPERATURE STABILIZED.						-16°F	-10°F	CYCLE #3: BEGIN TIME: 1200 BEGIN DATE: 9-2-93	☐ 9-2-93	☐ 9-2-93	
D013	III	-	VIS	REC	C1						
COMPLETION OF CYCLE #3. CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE. EXPOSURE TO -13 ± 3°F.						24 HRS	---	CYCLE #3 END TIME: 1230 END DATE: 9-3-93 (SEE COMMENT SHEET WHEN CHECKED) ☒ #4 TOTAL: 24 HRS. 30 min. HRS	☐ ~~12-3-93~~ 9-3-93		

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 5 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE	DATA MANAGEMENT			FINAL ACCEPTANCE		
INSPECTION INSTRUCTIONS	DESIGN LIMITS		DATA RECORDING	OPER	QUALITY	CUST/GOV
	MIN.	MAX.		STP-DT	STP-DT	STP-DT

DATA SHEET #1

LABEL SHIPPING CONTAINER WITH A PRESSURE SENSITIVE WATERPROOF LABEL. THE LABEL IS TO BE WHITE, WITH MINIMUM 3/8" BLACK LETTERS. AFFIX LABEL ON THE HUMIDITY INDICATOR SIDE OF CONTAINER, CENTERED BETWEEN THE MARKINGS "**HANDLE CAREFULLY**" AND "**DO NOT DROP**". LABEL IS TO CONTAIN THE FOLLOWING INFORMATION: (N/A DATA ENTRIES NOT REQUIRED.)

P 141 CS

9-3-93

ROCKET MOTOR	1 EA.	S/N OF MOTOR: S/N 1000734
CONTRACT NUMBER		CONTR. NO.: NAS8-36300
JRP RELEASE NUMBER		JRP #: 96534
DATE PACKAGED		DATE: 9/3/93
	WT: 307	
	CU: 14.74	
	L: 46	
	W: 26	
	H: 26	
MANUFACTURING DATE FROM MOTOR		DATE MFG.: 2/93
SHELF LIFE	8 YEARS	

Comment Sheet

PART NO.	SERIAL NO.	PLAN REV.	REL. NO.
B12000-14-01-501	1000734	Basic	96554 MFGA ~~96734~~

9-3-93

DESCRIPTION
BSM DELTA QUAL MOTOR TEST (FWD)

ITEM NO.	STEP NO.	COMMENT:
01	D003	

Chart # 1 has out of conditioning situation for one minute. With makeup time 2 minutes were deducted from total time. Total condition time is corrected.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO.	STEP NO.	COMMENT:
02	D005	

Chart # 2 cold cycle has 5 spikes on high temp. side and 4 spikes on low temp. side. These spikes are due to compressor cycling (noise). Total time is corrected. Spike duration is less than 2 seconds.

ORIGINATOR	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO.	STEP NO.	COMMENT:
03	D008	

In Chart # 4 there two spikes on cold temp. and 10 spikes on high temp. These spikes are due to compressor cycling (noise). Spike duration is less than 2 seconds.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO	STEP NO.	COMMENT:
04.	D013	

In Chart # 6 there are seven spikes on on high temp. and five on cold temp. . These spikes are due to compressor cycling (noise) Spike duration is less than 2 seconds.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	0184

CBD 2489 (85/05)

DISTRIBUTION: WHITE - STAY WITH JRP
PINK - UPON CLOSEOUT OF JRP, SHOP SUPERVISOR TO FORWARD T OORIGINATING PLANNER

BSM MOTOR S/N 1000738

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

APPROVAL NO:	CHANGE SHEET CONTROL NO. LOG PCS 040217, 040223 41841 41834	DAR REV: BASIC PICKLIST REV: CSMS	PAGE 1 OF 6
TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	MFG. RELEASE PLNG 8/27/93 Q.E. 8/20/93 ENGR 8/20/93 USBI 8/25/93	WORK ORDER RELEASE #: 5597-986-0000	REL #: MIGA 96533
PART NO: B12000-13-01-501 REV: *1 ECOs: NONE		QTY: 1 S/N: 1000738	MAT REV: BASIC
		NEXT ASSY: N/A	

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
0010-00-0	C0010T02	TRANSPORT PARTS/MATERIALS Production Control arrange transport of parts(s)/material(s) on Picklist to Station 1330 per MHC 2550.			
0020-00-0	T1330T09	TEMPERATURE CYCLING Perform Temperature Cycling in accordance with Operation 1 of Process Instruction 07.9.007, (Rev. Ø).	9-3-93	9-3-93	USBI 9-3-93
0030-00-0	C0010T02	TRANSPORT Production Control arrange transport of the Rocket Motor to Bldg. 0485 per MHC 2550.			
0040-00-0	P0485A61	SHIPPING CONTAINER Perform Shipping Container Operation in accordance with Operation 2 of Process Instruction 07.9.007, (Rev. Ø).	9/3/93		
0050-00-0	P0485A61	PACKAGE ROCKET MOTOR Perform Rocket Motor Packaging Operation in accordance with Operation 3 of Process Instruction 07.9.007, (Rev. Ø).	9-3-93		
0060-00-0	P0485A61	PALLETIZING Palletize motors and prepare for shipment in accordance with Operation 4 of Process Instruction 07.9.007, (Rev. Ø).	9-3-93		
0070-00-0	Q0485P99	Q.C. REVIEW Q.C. review documentation for completeness.		9-3-93	

OFFICIAL COPY

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)

PART NO: B12000-13-01-501

REL. #: MFGA 96533

MAT REV: BASIC

OPS	Q.C.	CUST
STP-DT	STP-DT	STP-DT

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS
0080-00-0	P0485A61	DOMESTIC SHIPMENT ADDRESS Perform domestic shipment address operation in accordance with Operation 5 of Process Instruction 07.9.007, (Rev. Ø).
0090-00-0	Q0485P99	USBI VERIFY USBI verify shipping documents for USBI Q.A.R. source release. Government review shipping documents

P 141 9/3/93

USBI 116 9-3-93

USBI 408 9-3-93

GOV'T 4332 9-3-93

7 SEE ATTACHED PAGES 3 OF 3
PCS 040217

NOTE

MSC activities.

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS
0100-00-0 0105-00-0	C0010T02	TRANSPORT PARTS/MATERIALS Production Control arrange transport of part(s)/material(s) from Receiving/Inspection to Station 0485 per MHC 2550.
~~0110-00-0~~ PCS 41834	~~P0485A61~~	~~NOTIFY X-RAY~~ ~~Ensure that the High Energy X-ray (HEX) personnel at ST-9 are ready to radiographically inspect the Rocket Motor. Do not proceed further until they have indicated that they are ready.~~
~~0120-00-0~~ PCS 41834	C0010T02	TRANSPORT Transport the Motor to HEX (ST-9) per MHC 2550.
~~0130-00-0~~ PCS 41834	T1319T07	CHECK Check the ~~insulation-wrapped-Rocket Motor for static charge~~ per Appendix 1 of Process Instruction 07.9.007, (Rev. Ø).

TECHNOLOGIES CHEMICAL SYSTEMS

MANUFACTURING ACCEPTANCE TRAVELER

PCS 040217 PG 2 OF 5

OCT 0 7 1993

CHANGE SHEET CONTROL NO. LOG					
TITLE: BSM ENVIRONMENTAL ROCKET MOTOR UNPACKAGE (FORWARD)		MFG. RELEASE	DAR REV. Basic	PICKLIST REV. Basic	PAGE 2A OF 6
PART NO. B12000-13-01-501	REV. 1	ECO's NONE	PLNG. Q.E. ENGR USBI	WORK ORDER RELEASE NO.	REL NO. MFGA 96533
				QTY.	SERIAL NO. / MAT REV. BASIC
OPER. / GROUP / STA.	OPERATIONS INSTRUCTIONS AFTRO			NEXT ASSY-END ITEM N/A	
				S/U HRS	RUN HRS / OPS STP-DTE / Q.C. STP-DTE

Special Considerations

0105-00-0

All operations directed by this MAT shall be performed within the scope of the CSD Safety Manual.

17

Verify all hoisting/lifing devices being used are within expiration dates.

Production Control arrange transportation of parts/materials on Picklist to Station 485.

Q.C. inspect visually for damage to shipping container. Make notations on Recap Sheet Complete on DAR Item PD001.
USBI VISUALLY INSPECT

OCT 0 7 1993

WARNING

THE ROCKET MOTOR SHALL BE GROUNDED AT ALL TIMES TO PREVENT ACCUMULATION OF STATIC CHARGES. TO PREVENT INADEQUATE SRM (SOLID ROCKET MOTOR) GROUNDING AND THE POSSIBILITY OF INADVERTENT IGNITION, ENSURE THAT THE ATTACHMENT CLIPS ON GROUNDING CABLE AND ATTACHMENT POINTS ARE CLEAN AND FREE FROM PAINT AND OTHER FOREIGN MATERIAL. WHEN WEIGHING MOTORS GROUND CABLES MAY BE REMOVED MOMENTARILY TO READ

TECHNOLOGIES CHEMICAL SYSTEMS

OCT 0 7 1993

MANUFACTURING ACCEPTANCE TRAVELER

TITLE: BSM ENVIRONMENTAL ROCKET MOTOR UNPACKAGE (FORWARD) PCS 040217 PG 3 OF 5							
PART NO. B12000-13-01-501			REL NO. MFGA 96533				PAGE 2B OF B6
OPER.	GROUP	STA.	OPERATIONS INSTRUCTIONS				MAT REV. BASIC
				S/U HRS	RUN HRS	OPS STP-DTE	Q.C. STP-DTE

Unpack motor assembly from shipping container per the following:

A) Remove wire and lead seal from lockring.

B) Remove lockring by removing bolt and nut.

C) Remove container lid and cushion insert. SEE COMMENT SHEET, ITEM # 2A

D) Remove desicant from container for regeneration.

E) Loose tie-rod nuts and remove top bearing plates.

F) Remove motor grounding strap from motor handling hole. Attach a station ground strap to the motor.

P 141 C S
OCT 0 7 1993

WARNING

ALL OVERHEAD CRANE/HOIST OPERATIONS REQUIRE THE USE OF HARD HATS BY CRANE/HOIST OPERATORS AND ALL PERSONNEL INVOLVED IN HOISTING OPERATIONS [illegible]

Pick up the motor assembly and [illegible] from shipping container, nozzle end up [illegible] point sling attached to the case aft flange lifting [illegible]

P 141 C S
OCT 0 7 1993

ORIGINAL PAGE IS OF POOR QUALITY

TECHNOLOGIES CHEMICAL SYSTEMS

MANUFACTURING ACCEPTANCE TRAVELER

293 CSO

OCT 07 1993

PCS 040217 PG 4 OF 5

TITLE: BSM ENVIRONMENTAL ROCKET MOTOR UNPACKAGE (FORWARD)							
PART NO. B12000-13-01-501			REL NO. MFGA 96533			PAGE 32 OF 36	
OPER.	GROUP	STA.	OPERATIONS INSTRUCTIONS	S/U HRS	RUN HRS	OPS STP-DTE	Q.C. STP-DTE

MAT REV. BASIC

Cross check the Serial Numbers recorded on Container Content Identification Tag and Motor. Verify that Serial Numbers are identical.
RECORD ON DAR ITEM PD002. Q.C. VERIFY.

P 141 CS OCT 07 1993

REMOVE WEATHER SEAL. REMOVE GREASE FROM INSIDE OF EXIT CONE.

SEE COMMENT SHEET, ITEM # 4A

Q.C. Visually inspect motors for any signs of physical damage. Record any notations on Recap Sheet, also Record on DAR Item PD003. AFQC Witness. (This step may be done out of sequence). USBI WITNESS.

293 CSO OCT 07 1993

Cover Motor Case with Kraft paper for protection if it is not corked. N/A if not applicable.

RE-GREASE INSIDE OF EXIT CONE AND INSTALL RUBBER THROAT PLUG.

P 141 CS OCT 07 1993

Place Motor Assembly in cradle supports on Work Table. Attach ground strap.

P 141 CS OCT 07 1993

Q.C. review documentation for completeness and Apply Accept Tag.

293 CSO 10-12-93

Production Control forward completed planning package to Data Acceptance Center.

ORIGINAL PAGE IS OF POOR QUALITY

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)		
PART NO: B12000-13-01-501	REL. #: MFGA 96533	
		MAT REV: BASIC

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
~~0140-00-0~~ (PCS 41834)	~~T1319T07~~	~~REMOVE WRAPPING~~ ~~When ready for radiographic inspection, slowly remove the wrapping from the Rocket Motor.~~ Check again for static charge per Appendix 1 of Process Instruction 07.9.007, (Rev. Ø).			
0150-00-0	Q1319Q99	VISUAL INSPECTTION (PCS 41834) Perform visual inspection AND ALCOHOL WIPE ~~OF~~ MK of Rocket Motor. Visual Inspection shall include an examination for surface corrosion. Reference operation 6 of Process Instruction 07.9.007, (Rev. Ø)			
0160-00-0 See Recap Item 1-4	Q1319Q99	RADIOGRAPHIC INSPECTION (PCS 040 223) Perform radiographic inspection of Rocket Motor. X-RAY TO WORK INSTRUCTION 60.12.9-217 Attach radiographic inspection report to this Job Release Package. Reference Operation 6 of Process Instruction 07.9.007, (Rev. Ø).		260 CSD 10-12-93	
0170-00-0	C0010T01	TRANSPORT PARTS/MATERIALS Production Control arrange transport of part(s)/material(s) on Picklist to Station 1330 per MHC 2550.		33 R CSD 10-13-93	
0180-00-0	T1330T09	PREPARE MOTOR Prepare and obtain pre-test measurements in accordance with Operation 7 of Process Instruction 07.9.007, (Rev. Ø).			
0190-00-0	T1330T09	CONDITION MOTOR Temperature condition motor in accordance with Operation 8 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 11-4-93		
0200-00-0	T1310T01	PREPARE FOR TEST Prepare for test in accordance with Operation 9 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 11-4-93		
0155-00-0		TRANSPORT PART(S)/MATERIAL(S). PRODUCTION CONTROL ARRANGE TRANSPORT OF PART(S)/MATERIAL(S) ON PICKLIST TO STATION 1319 PER MHC 2550.	23 CSD 11-4-93		
0165-00-0		TRANSPORT PART(S)/MATERIALS. PRODUCTION CONTROL ARRANGE TRANSPORT (PCS 41834)			

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)

PART NO: B12000-13-01-501

REL. #: MrGA 96533

MAT REV: BASIC

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
0210-00-0	T1310T01	COMBINED SYSTEMS TEST Conduct Combined Systems Test in accordance with Operation 10 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 11-4-93		
0220-00-0	T1310T01	STATIC TEST Conduct Static Test Firing in accordance with Operation 11 of Process Instruction 07.9.007, (Rev. Ø).	23 CSD 11-4-93		
0230-00-0	T1310T01	Q.C. REVIEW Q.C. review the "quick look" pressure and thrust plots to verify data recorded. Annotate motor serial number, planning release number and conditioning temperature on the plots. Attach plots to the MAT planning package.	23 CSD 11-4-93	105 11-4-93	USBI 680 11-4-93
0240-00-0	T1313T04	PERFORM POST-TEST Perform post-test activities in accordance with Operation 12 of Process Instruction 07.9.007, (Rev. Ø).	106 CSD 11/5/93		
0250-00-0	T1310T01	COPY DATA SHEET Area Supervisor forward copy of the completed Data Sheet to the Test Engineer. (This operation may be performed at any convenient time after Operation 0280.)			
0260-00-0	Q1310Q99	Q.C. REVIEW Quality Control review documentation for completeness, data entries and open items.		105 11-5-93	
0270-00-0	C0010T02	TRANSPORT MOTOR Production Control arrange for transportation of motor to Building 0485 per MHC 2550.			
0167-00-0 (PCS 41834)		COMPLETE OPERATION 6 OF PROCESS INSTRUCTION 07.9.007.	P 141 C S		

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)

PART NO: B12000-13-01-501

REL. #: MFGA 96533

MAT REV: BASIC

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
0280-00-0	C0010T02	FORWARD PLANNING Production Control forward planning package to Bldg. 0485.			
0290-00-0	P0485A61	DISASSEMBLY OF IGNITER FROM MOTOR Disassemble Igniter from Motor Case in accordance with Operation 13 of Process Instruction 07.9.007, (Rev. Ø).	P 141 CS 11-9-93		
0300-00-0	P0485A61	DISASSEMBLY OF NOZZLE FROM MOTOR Disassemble Nozzle from motor case in accordance with Operation 14 of Process Instruction 07.9.007, (Rev. Ø).			
0310-00-0	P0485A61	INSPECTION PLAN Engineering complete inspection plan. Engineering fill out attached data sheets.	ENGR		USBI
0320-00-0	P0485A61	TEST REPORT Engineering complete test report. USBI verify.	ENGR		USBI
0330-00-0	Q0485P99	Q.C. REVIEW AND GOV'T FINAL REVIEW Q.C. and Government review documentation for completeness and data entries.			GOV'T
0340-00-0	Q0485P99	FORWARD PLANNING Quality Control notify Production Control when planning is available for pick up.			

MANUFACTURING ACCEPTANCE TRAVELER

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)					
PART NO: B12000-13-01-501	REL. #: MFGA 96533		PAGE 6 OF 6		
			MAT REV: BASIC		
OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST STP-DT
0350-00-0	C0010T50	FORWARD PLANNING Production Control forward completed planning to the Data Acceptance Center.			

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	Q.E. [signature] 8/20/93 PSE [signature] 8/20/93 USBI [signature] 8/25/93	REL. #: MFGA 96533	PAGE 1 OF 18
		PART #: B12000-13-01-501	DAR REV: BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
D001	III	---	VIS	REC	C1	---	---	ACCEPTABLE	105 CSD 8-27-93	~~8-27-93~~ 8/27-93	USBI 8-27-93
INSPECT SETUP.											
D002	III	-	VIS	REC	C1	130°F	136°F	CYCLE #1: BEGIN TIME: 0835 BEGIN DATE: 8-28-93	8-28-93	13 CSD 8-28-93	
TEMPERATURE STABILIZED.											
D003	III	-	VIS	REC	C1			CYCLE #1: END TIME: 0905 END DATE: 8-29-93 (SEE COMMENT SHEET WHEN CHECKED) ☒	8-29-93		
COMPLETION OF CYCLE #1											
CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE.											
EXPOSURE TO 133 ± 3°F.											
D004	III	-	VIS	REC	C1	24 HRS	---	TOTAL: 24 HRS 28 min ~~30 min~~ HRS D23 CSD 8/29/93	SEE COMMENT SHT #1		
TEMPERATURE STABILIZED. GOV'T VERIFY (PLS 040223)						-16°F	-10°F	CYCLE #1: BEGIN TIME: 0950 BEGIN DATE: 8-29-93	8-29-93	13 8-29-93	GOV'T ~~7-14-93~~ 10-14-93

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 2 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
D005	III	-	VIS	REC	C1						
COMPLETION OF CYCLE #1.								CYCLE #1 END TIME: 1025 END DATE: 8-30-93	246 CSD 8-30-93		
CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE.								(SEE COMMENT SHEET WHEN CHECKED) ☒			
EXPOSURE TO -13 ± 3°F.						24 HRS	---	TOTAL: 24 HRS. ~~05 min~~ HRS D23 CSD 8/30/93	SEE COMMENT SHT. #2.		
D006	III	-	VIS	REC	C1						
TEMPERATURE STABILIZED.						130°F	136°F	CYCLE #2: BEGIN TIME: 1030 BEGIN DATE: 8-30-93	246 CSD 8-30-93	105 CSD 8-30-93	
D007	III	-	VIS	REC	C1						
COMPLETION OF CYCLE #2								CYCLE #2: END TIME: 1050 END DATE: 8-31-93	8-31-93		
CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE.								(SEE COMMENT SHEET WHEN CHECKED) ☐			
EXPOSURE TO 133 ± 3°F.						24 HRS	---	TOTAL: 24 Hours 20 min HRS			

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)								REL. #: MFGA 96533		PAGE 3 OF 18
								PART #: B12000-13-01-501		DAR REV: BASIC
ITEM	CAT	ZONE	METHODS	CODE	SOURCE	DATA MANAGEMENT			FINAL ACCEPTANCE		
INSPECTION INSTRUCTIONS						DESIGN LIMITS		DATA RECORDING	OPER	QUALITY	CUST/GOV
						MIN.	MAX.		STP-DT	STP-DT	STP-DT
D008	III	-	VIS	REC	C1						
TEMPERATURE STABILIZED. SEE COMMENT SHT. #3.						-16°F	-10°F	CYCLE #2: BEGIN TIME: 1110 BEGIN DATE: 8-31-93	8-31-93	8-31-93	
D009	III	-	VIS	REC	C1						
COMPLETION OF CYCLE #2.								CYCLE #2 END TIME: 1125 END DATE: 9-1-93	9-1-93		
CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE.								(SEE COMMENT SHEET WHEN CHECKED) ☒			
EXPOSURE TO -13± 3°F.						24 HRS	---	TOTAL: 24 HRS 15 MIN HRS			
D010	III	-	VIS	REC	C1						
TEMPERATURE STABILIZED.						130°F	136°F	CYCLE #3: BEGIN TIME: 1130 BEGIN DATE: 9-1-93	9-1-93	9-1-93	

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 4 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
D011	III	-	VIS	REC	C1						
COMPLETION OF CYCLE #3 CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE. EXPOSURE TO 133 ± 3°F.						24 HRS	—	CYCLE #3: END TIME: 1145 END DATE: 9-2-93 (SEE COMMENT SHEET WHEN CHECKED) ☐ TOTAL: 24 Hrs 15 min HRS	9-2-93		
D012	III	-	VIS	REC	C1						
TEMPERATURE STABILIZED.						-16°F	-10°F	CYCLE #3: BEGIN TIME: 1200 BEGIN DATE: 9-2-93	9-2-93	9-2-93	
D013	III	-	VIS	REC	C1						
COMPLETION OF CYCLE #3. CHECK BOX IF TOTAL CONDITIONING TIME WAS EXTENDED TO MAKE UP FOR OUT-OF-TOLERANCE TEMPERATURE. EXPOSURE TO -13 ± 3°F.						24 HRS	—	CYCLE #3 END TIME: 1230 END DATE: 9-3-93 (SEE COMMENT SHEET WHEN CHECKED) ☒ #4 TOTAL: 24 Hrs- 30 min HRS	9-3-93		

See Comment sheet #4

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 5 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN.	MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT

DATA SHEET #1

LABEL SHIPPING CONTAINER WITH A PRESSURE SENSITIVE WATERPROOF LABEL. THE LABEL IS TO BE WHITE, WITH MINIMUM 3/8" BLACK LETTERS. AFFIX LABEL ON THE HUMIDITY INDICATOR SIDE OF CONTAINER, CENTERED BETWEEN THE MARKINGS "**HANDLE CAREFULLY**" AND "**DO NOT DROP**". LABEL IS TO CONTAIN THE FOLLOWING INFORMATION: (N/A DATA ENTRIES NOT REQUIRED.)

P 141 CS
9-3-93

ROCKET MOTOR — 1 EA.

S/N OF MOTOR:
S/N 1000738

CONTRACT NUMBER — CONTR. NO.: NAS8-36300

JRP RELEASE NUMBER — JRP #: 96533

DATE PACKAGED — DATE: 9/3/93

WT: 307
CU: 14.74
L: 46
W: 26
H: 26

MANUFACTURING DATE FROM MOTOR — DATE MFG.: 2/93

SHELF LIFE — 8 YEARS

Comment Sheet

PART NO.	SERIAL NO.	PLAN REV.	REL NO.
B12000-13-01-501	1000738	Basic	MFGA-~~96738~~ 96533

DESCRIPTION
BSM DELTA QUAL MOTOR TEST (FWD)

D5
CSD
9-3-93

ITEM NO.	STEP NO.	COMMENT:
01	D003	

Chart # 1 has out of conditioning situation for one minute . With makeup time 2 minutes were deducted from total time . Total condition time is corrected.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO.	STEP NO.	COMMENT:
02	D005	

Chart # 2 cold cycle has 5 spikes on high temp. side and 4 spikes on low temp. side. These spikes are due to compressor cycling (noise) . Total time is corrected. Spike duration is less than 2 seconds.

ORIGINATOR	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO.	STEP NO.	COMMENT:
03	D008	

In Chart # 4 there two spikes on cold temp. and 10 spikes on high temp. These spikes are due to compressor cycling (noise). Spike duration is less than 2 seconds.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO	STEP NO.	COMMENT:
04.	D013	

In Chart # 6 there are seven spikes on on high temp. and five on cold temp. . These spikes are due to compressor cycling (noise) Spike duration is less than 2 seconds.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	0184

CSD 2489 (8/93)

DISTRIBUTION: WHITE - STAY WITH JRP
PINK - UPON CLOSEOUT OF JRP, SHOP SUPERVISOR TO FORWARD T OORIGINATING PLANNER

Appendix B

ENVIRONMENTAL TEST PROCEDURES AND PRETEST TEMPERATURE CONDITIONING HISTORY

(See Volume II for environmental test results)

BSM MOTOR S/N 1000734

S/N 1000734

Appendix A

ED 73-SHK-FOP-004

FACILITY OPERATING PROCEDURE
FOR PYROTECHNIC SHOCK TESTS
ED73-SHK-FOP-004

PREPARED BY: J. B. Herring — 12/9/92
James Herring/ED73
Test Engineer
DATE

PREPARED BY: Steve R Brewster — 12-9-92
Steve R. Brewster/ED73
Team Leader
DATE

APPROVED: [signature] — 12/10/92
C. ~~A.~~ Kirby/ED73
Chief, Dynamics Test Branch
DATE

APPROVED: Richard Y Leonard — 12/10/92
Richard Leonard/CS01
SAFETY
DATE

INTRODUCTION

1.1 PURPOSE

The purpose of this procedure is to define the steps necessary to perform a shock test in the Pyrotechnic Shock Facility in Building 4619 using blasting caps and mild detonating fuse (MDF) or flexible linear shaped charge (FLSC).

1.2 SCOPE

This document contains the steps to prepare the facility, conduct the test, and steps to follow in the event of misfires.

2.0 SAFETY

The operating policies set forth in EP01-SOP-01 "Standard Operating Procedure for Safety Critical Operations", shall be adhered to.

MSFC Medical Center	4-2390
Ambulance	122
Fire	117
Security	4-4357
Safety	4-0046

The Test Engineer will be responsible for personnel in the test activities and shall be notified immediately of any personnel activities.

3.0 APPLICABLE DOCUMENTS

EPT01-SOP-01, "Standard Operating Procedure for Safety Critical Operations"

ED73-SHK-SOP-006, "Safety Requirements and Procedures for the Operation of the Pyrotechnic Shock Facility"

AMC-R 385-100, Army Materiel Command Safety Manual

MM 1700.4, Safety and Environmental Health Standards

MMI 1710.6, MSFC Program for Personnel Certification

MMI 1710.1, Safety Review and Approval of MSFC Hazardous Activities

MMI 1345.1, Hazard Communication Program

NHB 1700.1(V1-A), Basic Safety Manual

DOD 6055.9, Ammunition and Explosives Safety Standard

0 GENERAL REQUIREMENTS

4.1 The Test Engineer will be in charge of all test preparations and activities.

4.2 All test activities shall be coordinated with the Test Engineer.

4.3 All changes to the procedure shall be coordinated with the Test Engineer.

0 ACCELEROMETER CALIBRATION

5.1 For each measurement location select an accelerometer of a type suitable for the amplitude expected.

5.2 Calibrate each accelerometer per ED73-SHK-FOP-008.

6.0 PRETEST FACILITY CHECKOUT

6.1 Verify that no flammable solvents, paints, gases, etc., are present in the hazardous area.

6.2 Verify that conductive floor mats are in place.

6.3 Verify floor mats and test, checkout, and assembly hardware are connected to the facility grounding system.

6.4 Verify the resistance of the conductive floor mats are less than 1 Ohm.
Recorded resistance reading ____________________ Ohm

6.5 Verify that no leads are connected to the junction box terminals.

6.6 Move junction box switch to "BULB" position.

6.7 Connect 12 Volts to the firing panel.

6.8 Insert firing key and verify panel meter indicates the correct voltage.

6.9 Switch key to "ARMED" position and verify power indicator light is illuminated.

6.10 Open red cover and flip firing switch, verify bulb on junction box lights.

6.11 Close red cover.

6.12 Switch key to "SAFE" position.

6.13 Move junction box switch to "METER" position.

6.14 Switch key to "ARMED" position and verify power indicator light is illuminated.

6.15 Open red cover and flip firing switch, verify that meter on junction box indicates 12 Volts.

6.16 Close red cover.

.17 Switch key to "SAFE" position and disconnect voltage source.

6.18 Remove firing key.

7.0 CHECKOUT, INSTALLATION, AND HOOKUP OF ORDNANCE

7.1 Verify Class 1.1 signs are posted on the outside walls of Room 170.

7.2 Verify that no severe weather or electrical storms are within 10 miles of the immediate vicinity.

7.3 Verify that no flammable solvents, paints, gases, etc., are present in the hazardous area.

7.4 Verify that conductive floor mats are in place.

7.5 Verify floor mats and test, checkout, and assembly hardware are connected to the facility grounding systems.

7.6 Verify the resistance of the conductive floor mats are less than 1 Ohm.
Recorded resistance reading ______________ Ohm

.7 Verify all non-essential personnel are clear of the test area.

7.8 Verify operational personnel are :

a. Wearing 100 percent cotton coveralls, shorts, undershirts, and socks, and street or safety shoes.

b. Remove all matches, lighters, jewelry, and all battery-powered devices such as electrical wrist watches, calculators; portable radios, etc.

7.9 During periods of connecting blasting caps, MDF, and FLSC, a maximum of two people (to be designated by the Test Engineer) will be permitted to remain in the area.

7.10 Verify that safety goggles, hearing protection, and wriststats or legstats are worn by personnel who will be installing explosive items.

7.11 Verify that the firing panel is in a "SAFE" condition and remove arming key from panel. The key is to be kept in the possession of the person installing the ordinance device.

.12 Turn on flashing light outside Room 170A.

..13 Install required MDF or FLSC on exciter plate.

7.14 Verify switch on junction box is in "BULB" position. ______

7.15 Using a wrist strap checker, each person wearing a wrist strap shall check their wrist strap. ______

7.16 In Room 170B, verify that blasting cap shorting foil is in place and is undamaged before removing from storage container. ______

7.17 Remove blasting cap from storage container and transport to Room 170. ______

7.18 In Room 170, verify that wristats or legstats are in place. ______

7.19 Install blasting cap on exciter plate. ______

7.20 Press blasting cap shorting foil firmly against facility ground for 1 second. ______

7.21 In order to short the leads, slide enough shorting foil off blasting cap to attach an alligator clip. ______

7.22 Remove shorting foil: ______

7.23 Move switch on junction box to "BULB" position. ______

7.19 Verify that bulb on junction box is not illuminated. ______

WARNING:

IF BULB GLOWS, THERE IS SUFFICIENT RADIO FREQUENCY IN THE AREA TO POSSIBLY CAUSE DETONATION OF THE BLASTING CAP. THE CAP SHOULD BE LEFT SHORTED AND RETURNED TO ROOM 170B STORAGE CABINET. ALL BLASTING ACTIVITIES WILL BE CURTAILED UNTIL THE RF SOURCE IS REMOVED.

7.20 Move switch on junction box to "METER" position. ______

7.21 Verify 0 volts on meter. ______

WARNING:

IF VOLTAGE IS INDICATED, THE LINES TO THE FIRING PANEL ARE EITHER CONNECTED TO A VOLTAGE SOURCE OR ARE PICKING UP VOLTAGE FROM RADIATION CAUSED BY A NEARBY SOURCE. THE CAP SHOULD BE LEFT SHORTED AND RETURNED TO ROOM 170B STORAGE CABINET. ALL BLASTING ACTIVITIES WILL BE CURTAILED UNTIL THE VOLTAGE SOURCE IS REMOVED.

2 Move junction box switch to "BULB" position. ____

7.23 Install blasting cap leads in junction box, move switch to "FIRE" position and remove alligator clip. ____

7.24 Leave area, close door, and inform Test Engineer of status. ____

8.0 DETONATION

8.1 Test Engineer will insure that only essential personnel remain in Room 170A. ____

8.2 Prepare data acquisition system to acquire data. ____

8.3 Connect firing panel voltage supply and insert firing key, verify that meter indicates the appropriate voltage. ____

8.4 Start tape recorder. ____

8.5 Begin countdown. ____

8.6 On the count of 3, put switch in "ARMED" position, verify that power indicator is illuminated. ____

On the fire command, open red cover and flip firing switch. ____

8.8 Turn the firing panel key to the "UNARMED" position. ____

8.9 Remove arming key and disconnect voltage supply. ____

NOTE:

IF BLASTING CAP DOES NOT FIRE, PROCEED TO SECTION 10.4
IF MDF OR FLSC SEGMENTS DO NOT FIRE, PROCEED TO SECTION 10.5

0 POST DETONATION

9.1 Wait a minimum of 5 minutes after firing before opening door to Room 170. _____

9.2 Turn off flashing light outside Room 170A. _____

9.3 Inform Test Engineer that door is to be opened. _____

9.4 In Room 170, move junction box switch to "BULB" position. _____

9.5 Remove blasting cap leads from junction box. _____

9.6 Inspect exciter panel to insure all explosive devices fired properly. _____

9.7 Verify all operational personnel are wearing wrist straps. _____

NOTE:

IF ALL EXPLOSIVE ITEMS DID NOT FIRE, GO TO EMERGENCY PROCEDURES, SECTION 10.0

10.0 EMERGENCY PROCEDURES

.0.1 During Installation and Connection of Ordnance Items: Operational personnel shall immediately stop operations and evacuate the test area when:

a. A fire is reported in the immediate vicinity.
b. A fire or electrical short occurs in the test area.

Operational personnel shall immediately stop operations when:

a: When lightning is detected within 10 miles of the vicinity.
b: When severe weather is reported in the vicinity.
c: Loss of facility power in the test area.
d: Significant radio frequency disturbances exist in the vicinity.

Any such occurrence shall be immediately reported to the ED73 Test Engineer

.0.2 After Accidental Ordnance Detonation

The following actions shall be taken in the event of an accidental detonation of an ordnance device.

a. In the event of serious personnel injury, do no move the injured person unless necessary to prevent further serious injury.
b. Call ambulance (112) and/or fire department (117) if required.
d. Notify ED73 Test Engineer.

DO NOT TRY TO FIGHT ANY RESULTING FIRE IF THERE ARE OTHER ORDNANCE DEVICES IN THE AREA.

10.3 During Firing Countdown Operations

If evacuation of the area is directed by the ED73 Test Engineer:
a. Switch key to "SAFE" position, remove arming key, and disconnect firing panel power.
b. Evacuate the area as directed. ______

10.4 Blasting Cap Does Not Fire

10.4.1 Attempt to fire cap by closing "FIRE" switch and leaving engaged for 1 minute. Repeat a minimum of three times. If blasting cap fires, continue procedure at Section 9.0 ______

10.4.2 Switch key to "SAFE" position, remove arming key, and disconnect firing panel power. ______

10.4.3 Wait 30 minutes before entering Room 170. ______

10.4.4 Put on safety goggles, hearing protectors, and wriststats. ______

10.4.5 In Room 170, move junction box switch to "METER" position. ______

10.4.6 Leave room and close door. ______

10.4.7 Connect firing panel power, insert arming key, and switch to "ARMED" position. ______

10.4.8 Open red cover and flip firing switch, verify voltage registers on junction box meter. ______

10.4.9 Switch key to "SAFE" position, remove arming key, and disconnect firing panel power. ______

10.4.10 Put on safety goggles, hearing protectors, and wriststats. ______

.4.11	In Room 170, move junction box switch to "ARMED" position.	
10.4.12	Leave room and close door.	____
10.4.13	Increase voltage at power source by 50%.	____
10.4.14	Connect firing panel power, insert arming key, and switch to "ARMED" position.	____
10.4.15	Open red cover and flip firing switch. If blasting cap fires, continue procedure at Section 9.0	____ ____
10.4.16	Switch key to "SAFE" position, remove arming key, and disconnect firing panel power.	
10.4.17	If blasting cap does not fire, wait 30 minutes before entering Room 170.	____
10.4.18	Obtain explosive misfire container.	____
10.4.19	Put on safety goggles, hearing protectors, and wriststats.	____
).4.20	In Room 170, move junction box switch to "BULB" position.	____
0.4.21	Short blasting cap leads by twisting leads together and secure with an alligator clip.	____
10.4.22	Remove blasting cap by using mechanical devices	____
10.4.23	Place cap in explosive misfire container until turned over to Army for disposal.	____ ____

10.5 MDF/FLSC Segments Do Not Fire After Blasting Cap Detonation

10.5.1 Switch key to "SAFE" position, remove arming key, and disconnect firing panel power. ______

10.5.2 Test Engineer will insure that no one enters Room 170 for a period of 1 hour after blasting cap detonation. ______

10.5.3 At the end of the required waiting period, put on safety goggles, hearing protectors, and wriststats. ______

10.5.4 In Room 170, examine explosive to determine if it is feasible to detonate by use of another blasting cap. ______

If another blasting cap may be used, continue procedure at Section 7.10.

10.5.5 Obtain explosive misfire container. ______

10.5.6 Use mechanical devices to remove explosive and place in explosive misfire container. ______

Appendix B

Test Procedure Deviation

Figure 1

TEST PROCEDURE DEVIATION		TCP NO.:
TEST ENGINEER:	QUALITY:	DATE
REQUIREMENTS ENGINEER:	OTHER:	
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS:

Appendix C

Figures

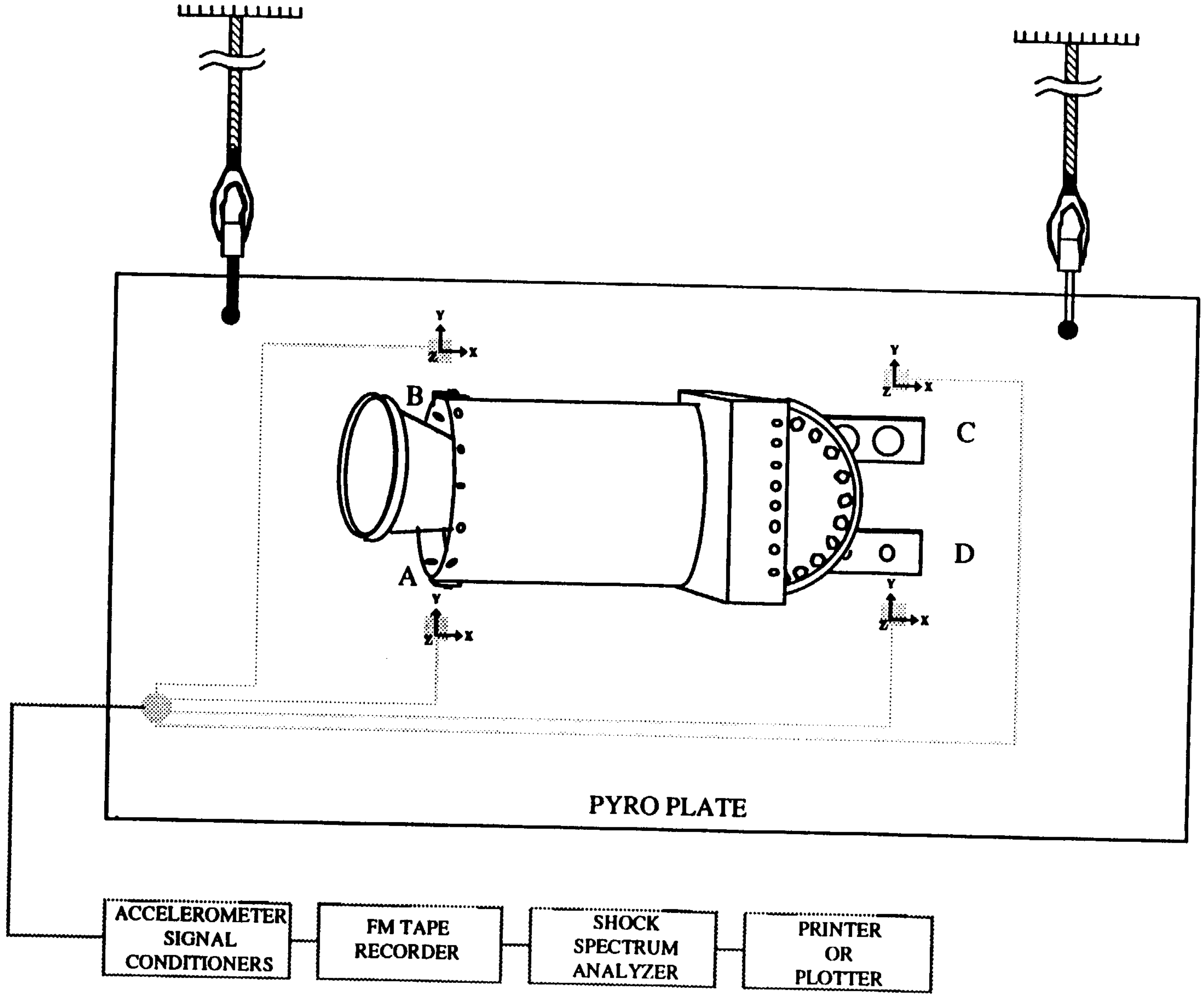


FIGURE 1. PYRO SHOCK CONTROL EQUIPTMENT

DRAWN BY: K.MITCHELL / EP54 4/15/93

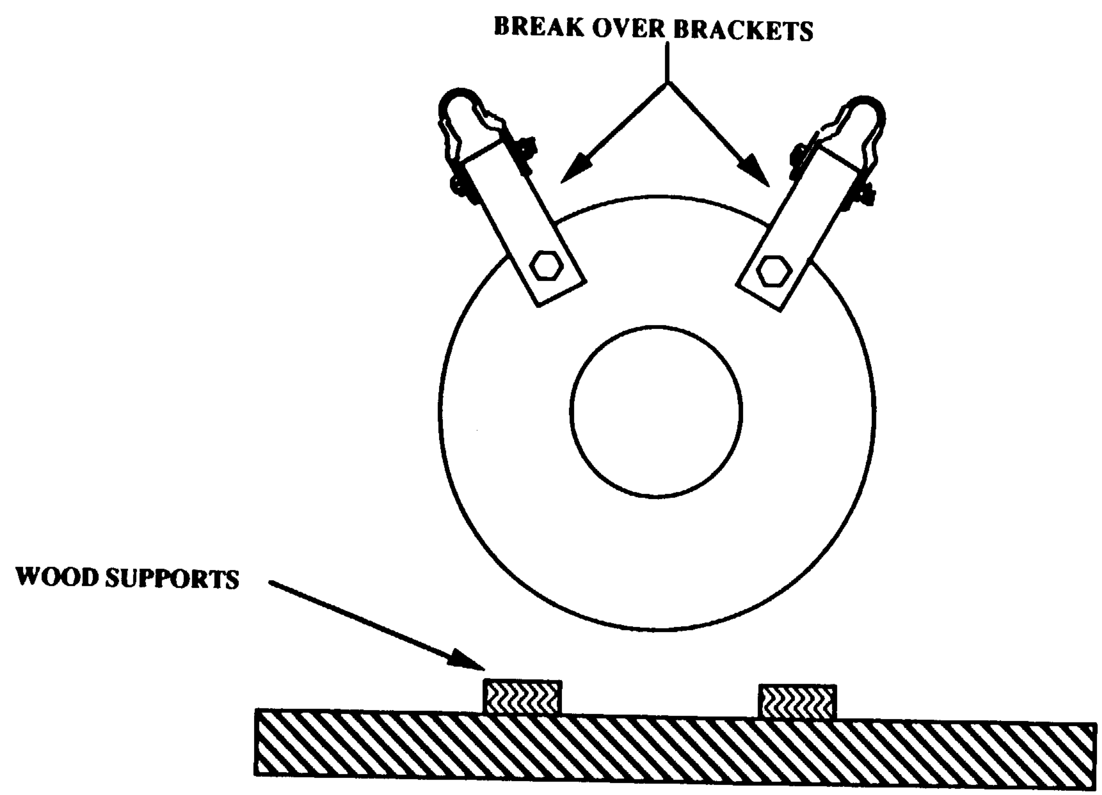


FIGURE 2. BREAK OVER BRACKET ASSEMBLY

DRAWN BY:
K.MITCHELL / BP54
3/8/93

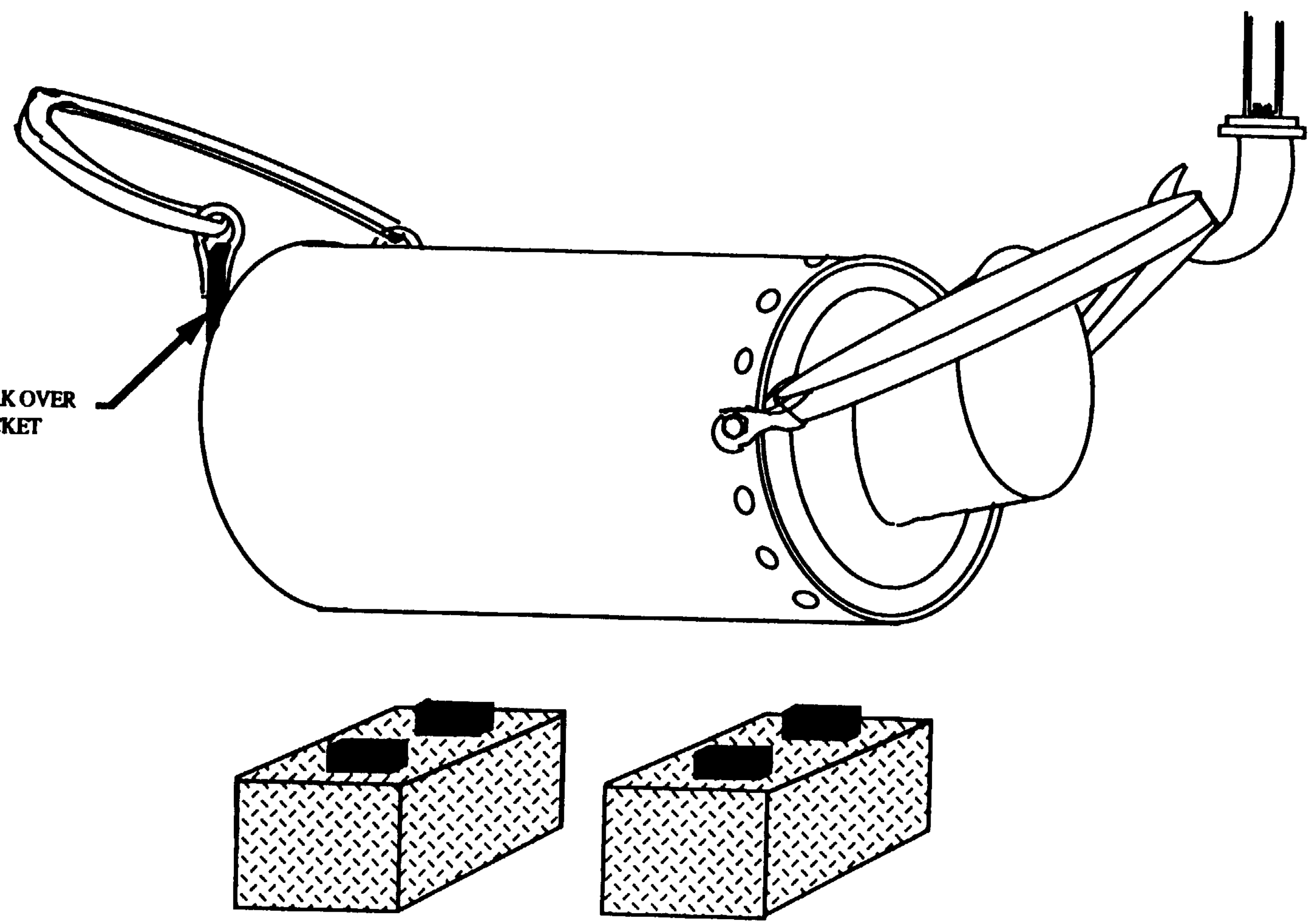


FIGURE 3. HORIZONTAL BREAKOVER

DRAWN BY :
K.MITCHELL / EP54

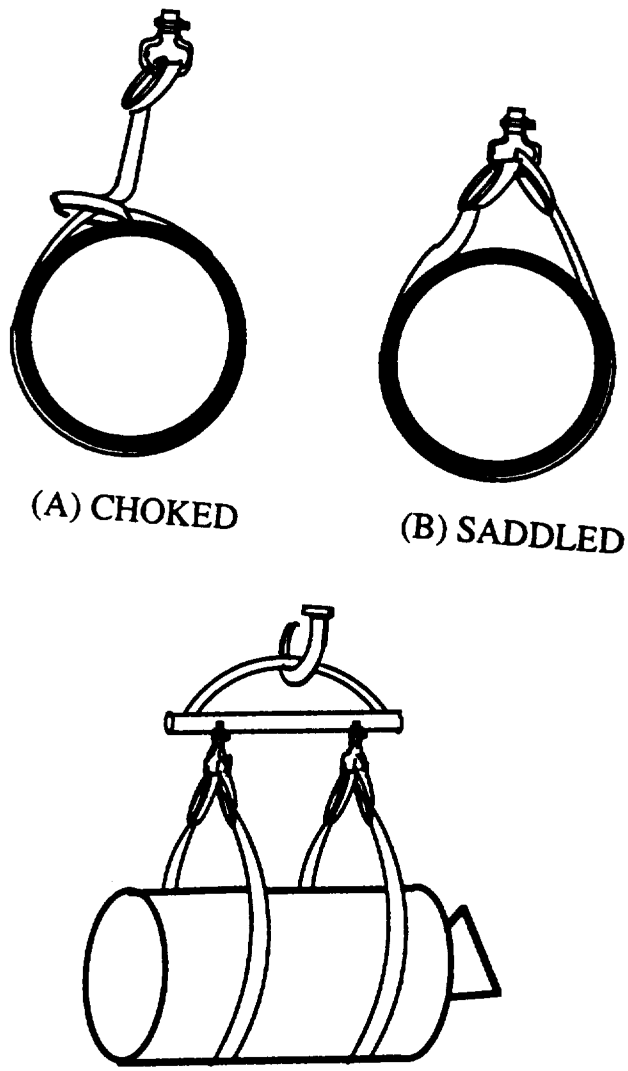


FIGURE 4. LIFTING STRAP ATTACHMENTS

DRAWN BY:
K. MITCHELL/EP54
3/8/93

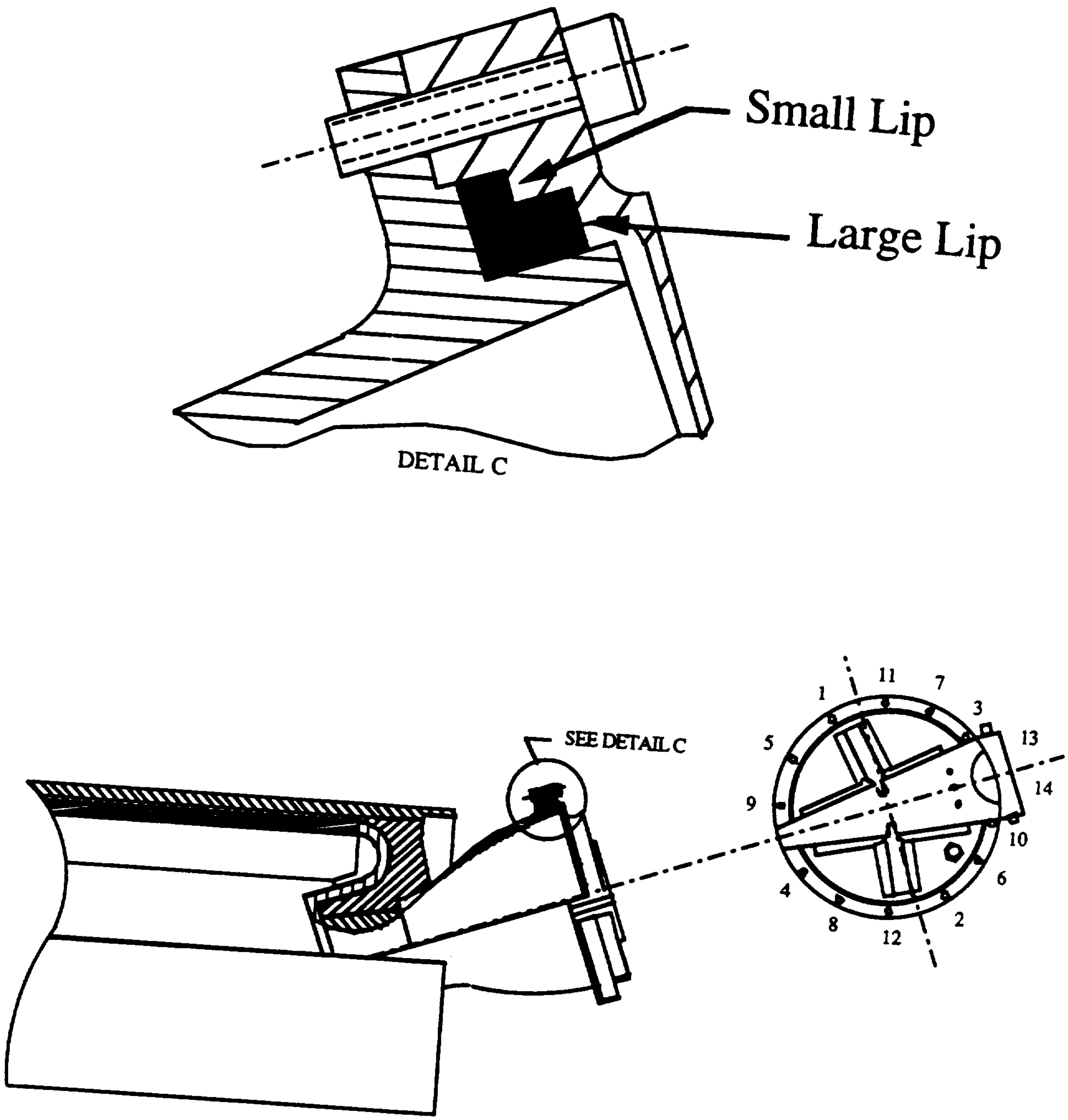


FIGURE 5. AERO HEAT SHIELD SEAL

DRAWN BY:
K. MITCHELL
4/9/93

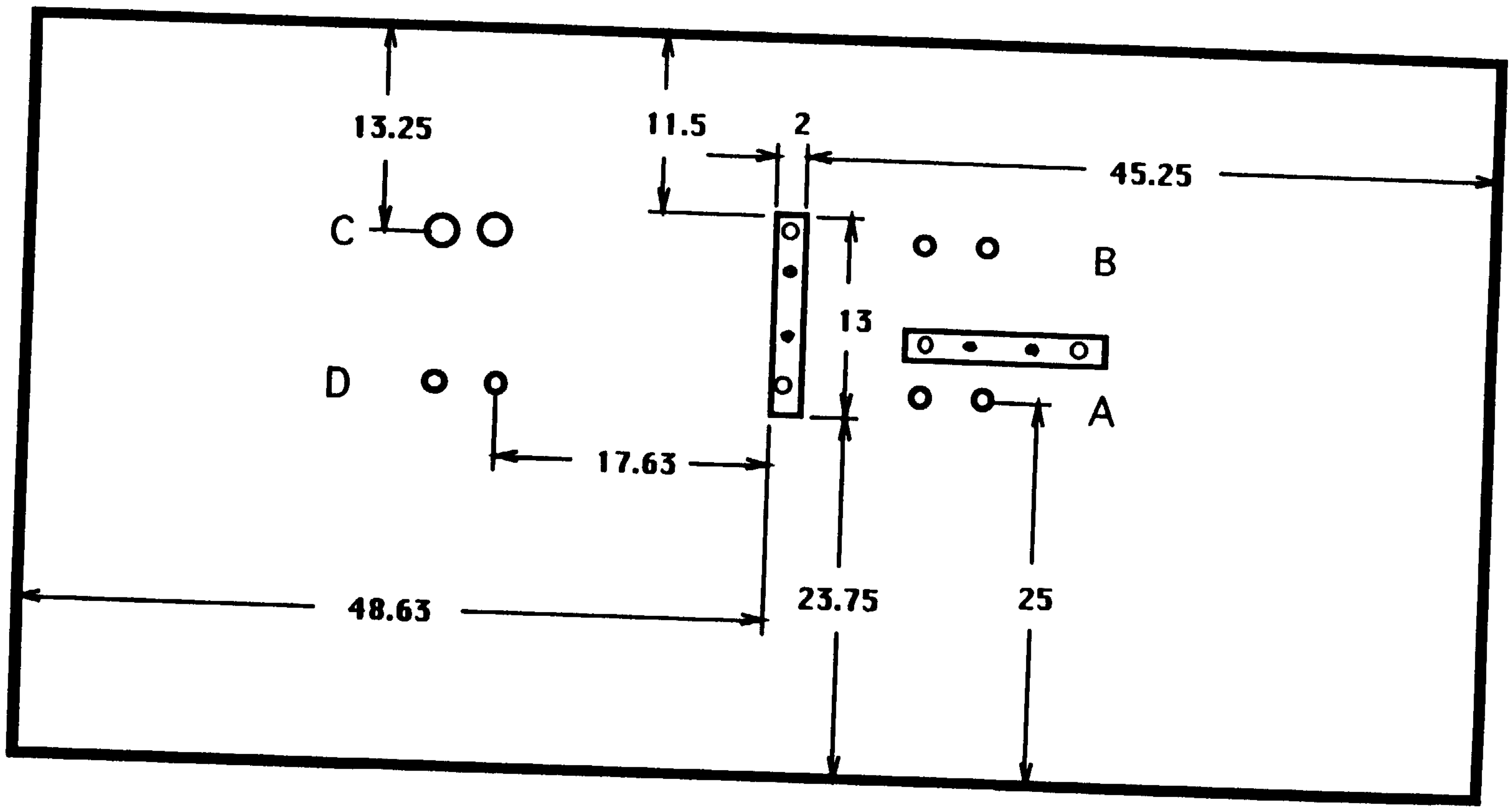


FIGURE 6. LOCATION OF BARS

* DIMENSIONS ARE IN INCHES

DRAWN BY:
K.MITCHELL/BP12
9/9/93

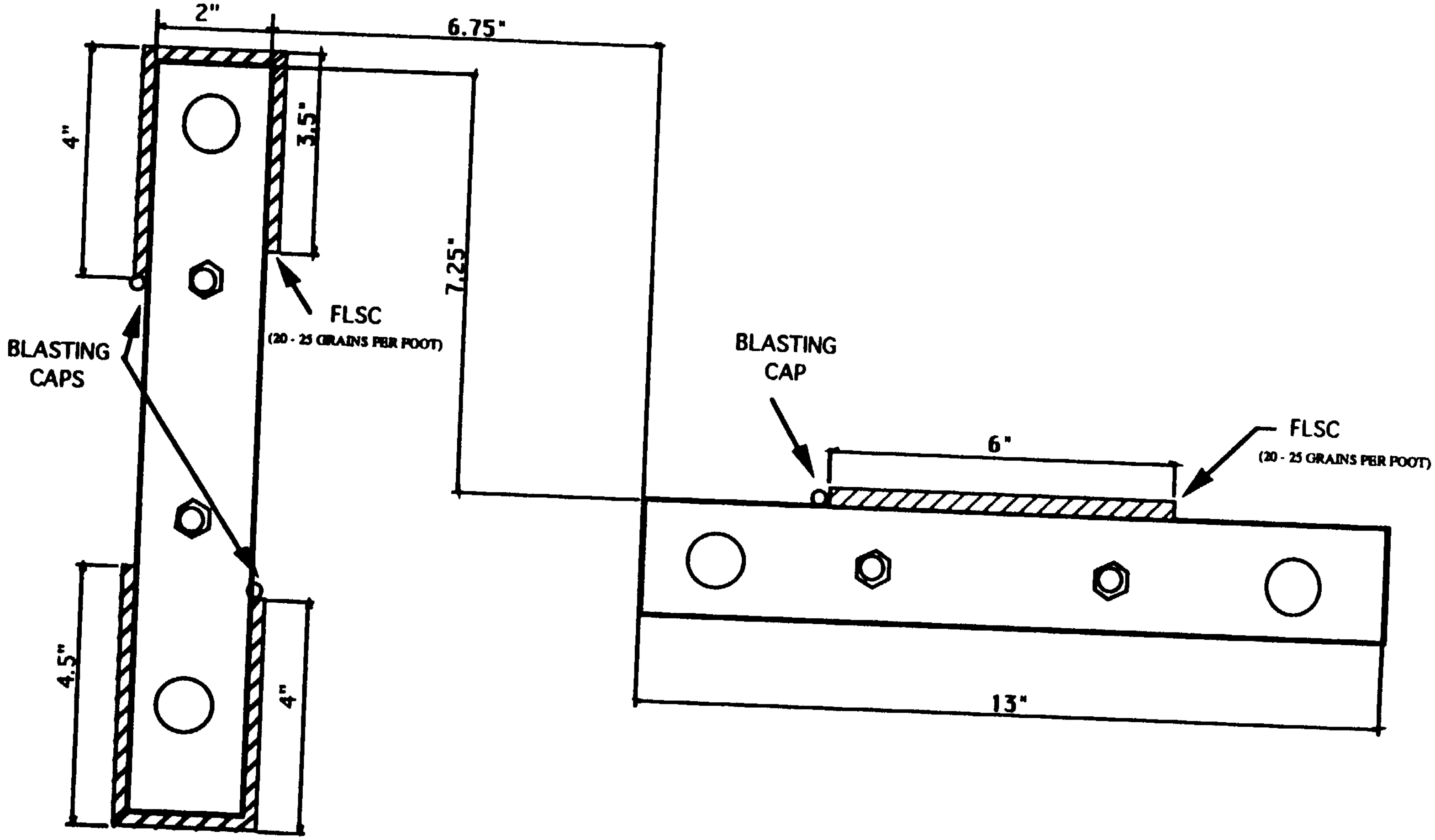


FIGURE 7. FLSC CONFIGURATION

DRAWN BY:
K.MITCHELL / EP12
9/9/93

Appendix D

Tool List

TORQUE WRENCHES:

Torque	Drive	Cal. Due	SN	Use	Owner
250 ft - lbs	1/2"	01/20/94	EMJ00359	Pos. C Bracket	Bill S.
100 ft - lbs	3/8"	10/05/93	BTW-2RCF	A, B, D, Bracket	McGee
25 in - lbs	3/8"	10/05/93	5492304	AHS Fasteners	McGee
750 in - lbs	3/8"	??????	T-267-GL	Ship. Cont. Grnd.	McGee
150 in - lbs	3/8"	08/24/93	52117		McGee
100 ft - lbs	1/2"	10/05/93	7011013		McGee

RATCHETS

1/2" drive
3/8" drive

HANDLES

1/2" drive (long)
3/8" drive
1/4" screwdriver handle
1/4" slide handle

SOCKETS

Size	Drive	Type
3/4"	1/2"	regular
	3/8"	regular
	1/2"	deep well
5/8"	1/2"	regular
	1/2"	deep well
25/32"	1/2"	deep well
11/16"	3/8"	regular
	3/8"	deep well
	3/8"	regular-elbow
1/2"	3/8"	regular
	3/8"	deep well
9/16"	3/8"	regular

1/4"	1/4"	regular (AHS)
3/8"	3/8"	regular

ADAPTERS AND EXTENSIONS

Size	Type
1/2" to 1/2"	extension
1/2" to 3/8"	extension
3/8" to 3/8"	extension
3/8" to 1/2"	adapter
3/8" to 1/4"	adapter
3/8" to 3/8"	adapter (elbow)

ALLEN HEAD SOCKETS

1/2" drive to 9/16"
1/2" drive to 1/2"
1/2" drive to 3/8"
3/8" allen
3/8" allen (cut-off)

BOX END AND OPEN END WRENCHES

11/16" box end
9/16" box end
1/2" box end

1/2" open end

OTHER TOOLS

Pipe extension

Special wrenches for inspection plate nuts

Appendix E

Proof Load Inspection Sheets

Lifting Equipment Inspection Sheet

1. **PCH Identification**
   a. Nomenclature:
   b. SN:

2. **Handling Procedure Number**

3. **Location of Lift (Fac. Bldg.)**
   a. Building: ____________
   b. Date of lift: ____________

4. **Weight to be Lifted (in lbs.)**
   a. Item: ____________
   b. Hoisting Equipment ____________
   c. Total: ____________

5. **Checklist**

   a. Assessment Prior to Critical Lift

      1. Maintenance records ____________
      2. Equipment tagged with appropriate max working loads ____________
      3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
      4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

   b. Operator's Certification Validation:

      Crane ____________ Rigger ____________ Flagman ____________

      Forklift ____________ Driver ____________ Personnel Hoist ____________

   c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

   d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. **For additional information, observations and remarks**

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ______ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. **PCH Identification**

   a. Nomenclature:

   b. SN:

2. **Handling Procedure Number**

3. **Location of Lift (Fac. Bldg.)**

   a. Building: ____________

   b. Date of lift: ____________

4. **Weight to be Lifted (in lbs.)**

   a. Item: ____________

   b. Hoisting Equipment ____________

   c. Total: ____________

5. **Checklist**

   a. Assessment Prior to Critical Lift

      1. Maintenance records ____________
      2. Equipment tagged with appropriate max working loads ____________
      3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
      4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

   b. Operator's Certification Validation:

      Crane ____________ Rigger ____________ Flagman ____________

      Forklift ____________ Driver ____________ Personnel Hoist ____________

   c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

   d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. **For additional information, observations and remarks**

____

____

____

<u>I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.</u>

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

<u>I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.</u>

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

BSM-TCP-EP54-002

BSM Delta Qualification Test

Move BSM from Pyro to Vibration / Setup Thermal Conditioning

This Procedure Describes **Safety Critical** Operations

MSFC - Cover 2 (Rev. June 1980)

BSM-TCP-EP54-002

BSM Delta Qualification Test

Move BSM from Pyro to Vibration / Setup Thermal Conditioning

Prepared by:

Mat Bevill EP-12

08/16/93

Motor SN: 1000734

Test Date: 09/22/93

Move BSM from Pyro to Vibration / Setup Thermal Conditioning

Prepared by:	Mat Bevill/MSFC TE/EP12	9/15/93 Date
Approved by:	Jim McGee/MSFC Vibration Lab TE	9-14-93 Date
	Jim Herring/MSFC Pyro Shock Lab TE	9-14-93 Date
	Richard Leonard/MSFC Safety/CS01	9-16-93 Date
	Rick Clements/MSFC Quality/CQ06	9-15-93 Date
	Ben Goldberg/Motor Systems Division/EP11	9/14/93 Date
	Steve Brewster/Dynamic Test Branch/ED73	9/14/93 Date
	Chuck Wells/UTC/CSD TE	9/16/93 Date
	Don Wencil/USBI	9-14-93 Date
	Charlie Lovell/PCH Engineer/CN71	9/16/93 Date

Move BSM from Pyro to Vibration / Setup Thermal Conditioning

Prepared by: Mat Bevill — 09/15/93
Mat Bevill/MSFC TE/EP12 — Date

Approved by: Jim McGee — 9-14-93
Jim McGee/MSFC Vibration Lab TE — Date

Jim Herring — 9-14-93
Jim Herring/MSFC Pyro Shock Lab TE — Date

Richard Y Leonard — 9-16-93
Richard Leonard/MSFC Safety/CS01 — Date

Rick Clements — 9-15-93
Rick Clements/MSFC Quality/CQ06 — Date

Benjamin E Goldberg — 9/14/93
Ben Goldberg/Motor Systems Division/EP11 — Date

9/14/93
Steve Brewster/Dynamic Test Branch/ED73 — Date

Chuck Wells/UTC/CSD TE — Date

Donald N. Wencil — 9-14-93
Don Wencil/USBI — Date

Charles W. Lovell — 9/16/93
Charlie Lovell/PCH Engineer/CN71 — Date

Table of Contents

1.0 General Information

1.1 Scope

This test procedure addresses all the requirements to perform the move of the BSM from the pyro test facility to the vibration test facility along with the thermal conditioning setup for the Radial Axis vibration test.

1.2 Objective

The objective of the dynamic testing is to verify the physical and functional survivability of the Booster Separation Motors. Of particular interest for these tests are the components bonded using EA9394 adhesive. The components using this adhesive include the throat insert, the centering insert, and the igniter grain support rod.

2.0 Applicable Documents

MSFC-STD-513A	Certification of Equipment Operations and Materials Handling Personnel
EG5300.36A	Safety
29 CFR 1910	Occupational Safety and Health Administration (OSHA)
NSS/GO 1740.9	Safety Standard for Lifting Devices and Equipment
NHB 1700.1(V1)	Basic Safety Manual
AMC-R 385-100	Safety Manual
EP01-SOP-01	Standard Operating Procedure for Safety Critical Operations
MM 1700.4	Safety and Environmental Health Hazards
MMI 1700.17	MSFC Procedures for Acquiring Shipping Permits for Rocket Motors and Igniters
MMI 1710.1	Safety Review and Approval of Hazardous and Potentially Hazardous Facilities and Activities at MSFC
MMI 1710.6	MSFC Program for Personnel Certification
MMI 1711.2	Mishap Reporting and Investigation

MMI 1845.1	Hazard Communication Program
MMI 6400.2	Packaging, Handling, and Moving Program Critical Hardware
MSFC-RQMT-1493	Electrostatic Discharge Control Requirements
MSFC-STD-1800	Electrostatic Discharge (ESD) Control for Propellant and Explosive Devices
MSFC-STD-126E	Inspection, Maintenance, Proof Testing and Certification of Handling Equipment
CSD-5597-93-1 Rev. B	Enhanced Delta Qualification Test Plan for Booster Separation Motor (BSM), Aug. 6, 1993
10SPC-0067 Rev. A	Specification for Booster Separation Motors for Space Shuttle Solid Rocket Booster (thru SCN 014)

3.0 **Safety**

3.1 The following safety criteria are in accordance with ET01-SOP-01, Rev. A., *Standard Operation Procedures for Safety Critical Operations*".If safety rules/regulations are not followed,injury to personnel and/or damage to test items could occur.

Emergency telephone numbers are as follows:

Safety	4-0046
Ambulance	112
Fire	117
Security	4-4357
Utilities	4-3919
Medical Center	4-2390
Communication Repair	4-1771

3.2 Prior to starting work in 4619 a visual inspection of the work area shall be made for anomalies by task supervisor and safety personnel.

MSFC TE JA MSFC SE RM

Date / Time: 9/23/93 / 3:00 am

3.3 Personnel shall not work or position themselves beneath suspended loads unless such loads are securely and adequately blocked up.

9-23-93

3.4 Objects handled by overhead hoist shall be lifted only high enough to clear fixed objects in the path of travel. Spreader bars and slings may be left on the hoist if desired when not in use, but must be raised so that the lowest part of the lifting equipment will be at least seven feet from the floor when not in use.

3.5 Crane, hoist, lift prime operators, and riggers shall be certified according to the latest revision of MMI 1710.6, and shall have in their possession a valid certification card.

Certifications checked by: JH

Date / Time: 9/23/93

3.6 Personnel working around suspended loads shall be alert to the possibility of being crushed between the suspended load and a fixed object.

3.7 Loads shall be moved slowly so they will not accumulate more momentum than can be stopped with little or no swing.

3.8 Where handling slings are called out, a sling with more pickup points than required may be used if the weight capacity per point used is equal or greater than the weight capacity of each point of the noted sling and the free pickup point is (are) secured to prevent it (them) from swinging and causing damage to parts.

3.9 Only the area coordinator should direct the crane moves, however, any person determining an immediate danger or problem may request stoppage of activities.

3.10 The lifting or transportation operation shall be halted by the area coordinator at any time the control area cannot be maintained.

3.11 Steel toe shoes are required during lifting operations. Hardhats are required when the lift is at or above the shoulders.

3.12 Tag line operators are to wear leather gloves.

3.13 The primary safety hazards associated with this operation are:

3.13.1 Lift operations
3.13.2 Solvent Use (See NOTE)
3.13.3 Live (Loaded) Solid Rocket Motor

9-23-93

NOTE: Grease and solvent use are only "if needed" as determined by the MSFC TE and CSD TE.

3.14 Any time a crane is being used, it must be dogged if:

3.14.1 The load will be suspended in a static condition for an extended amount of time.

3.14.2 A crane operator crew change or substitution must be made.

3.15 No electric power tools shall be used near the live test item. Use of pneumatic tools is acceptable.

3.16 All ground cables and ground straps end-to-end resistances shall be verified with a multimeter. These resistances must measure less than 1 ohm.

3.17 All personnel within touching distance of the BSM or ordnance shall wear a wrist strap that has been checked with a wrist strap checker. This step should be performed each time the wrist strap ground is broken.

3.18 All personnel within touching distance of open grain propellant (and ordnance) shall wear antistatic coveralls.

4.0 Test Items and Test Requirements

4.1 Test Items

The test item for the delta qualification vibration tests consists of a live BSM which will be tested in the aft motor configuration. The motor will be tested with an aero heat shield over the exit cone. The motor weighs approximately 154 pounds each.

4.2 Test Requirements

4.2.1 Test Tolerances

Unless otherwise stated in this procedure, the tolerances applicable to the test conditions described shall be as specified in MIL-STD-810D. These tolerances are as follows:

Temperature: $\pm 5°$ F

4.2.2 Test Data

All data taken with non-recording instruments will be recorded in ink directly onto data sheets and/or log sheets. The log or data sheets will identify the test being performed, the test item, the item part number, and the applicable test procedure. Corrections or changes will be made by drawing a single line through the original entry. The new entry will be made directly above the old and initialed by the person making the entry. Each page will be signed and dated at the bottom of the page by the person making the entries, and counter signed by the test engineer after review.

4.3 Test Conditions

The live delta qualification motor will be vibration tested at a specific temperature. The motor will be either be tested at 25°F or at 125°F depending on which motor is controlled by this procedure.

4.3.1 The MSFC TE is responsible for checking the weather conditions before the move. The test site's relative humidity must be above 20%. If the humidity is not above 20%, all move operations will be postponed until favorable weather conditions resume. H✓

Test site's relative humidity: 87% MSFC TE JH

9/23/93 12:05

4.3.2 The MSFC TE shall check with the Army MET team to ensure that there is no lighting within 10 miles. (MET team phone number....876-2465). [✓

4.3.2.1 If lightning is within 10 miles during any time that a live BSM is in building 4619, the MSFC TE shall make arrangements to disconnect the motor ground from the facility ground. The motor shall remain ungrounded until the lightning is out of range.

4.3.2.2 When reconnecting the ground after a lightning storm, a 100Kohm resistor should be connected to the ground wire from the motor before connecting to facility ground. This allows any charge on the motor to slowly dissipate to ground. The resistor should be left connected for no less than 30 seconds.

4.3.2.3 After the specified time, disconnect the ground wire from facility ground and remove the resistor. Reconnect the ground strap from the motor to facility ground.

9-23-93

4.3.3 It is not recommended to transport the motor in the rain. However, if the motor must be moved in the rain, it should be wrapped in Velostat and sealed with conductive tape.

4.4 Test Equipment

4.4.1 All measurements shall be made with instruments and equipment whose accuracy and/or calibration has been verified.

Calibration Acceptable JH (MFSC TE)

4.4.2 Proof Loading of Handling Equipment (required for PCH)

4.4.2.1 The heaviest lift during all of the delta qualification testing will be lifting the motor while in its shipping container. The motor and shipping container together weigh about 310 lbs. All forklifts and overhead hoists must be load (break) tested to at least 110% of this weight (i.e. 350 lbs.). This test must be performed prior to any handling of the BSM but does not need to be repeated until something other than the BSM is lifted by the same handling equipment. It is therefore recommended that the break tests be performed each evening before the BSM testing commences. The break tests shall be performed as follows: [✓]

a. The proof load must be at least 350 lbs.

b. Lift the dummy load clear of the ground (less than 1 foot) and lower to ground three times, holding for five minutes on the third lift. Lifting straps and spreader bar should be attached during the lift.

SEE APPENDIX B FOR THE PROOF TEST INSPECTION SHEETS.

4.5 Procedure for the Move and Setup

4.5.1 After review and documented approval, a redline change to this procedure may be performed. Approval shall be by a minimum of the MSFC TE, MSFC SE, and the MSFC QA.

4.5.2 As soon as possible after a test failure, a deviation from the specified test environment, or any other incident which affects the test or test item, MSFC will notify the authorized UT/CSD representative of the event verbally and will then generate a Test Procedure Deviation (NASA form 3959). A copy of the Test Procedure Deviation is presented in Appendix A. Photographs of any discrepancies shall also be taken.

9-23-93

5.0 Personnel Responsibilities

5.1 Test Witnessing

All tests will be witnessed by the authorized UT/CSD representative and USBI representative. The MSFC test engineer will also witness the testing (moving and setup). Notification of the start of the move shall be communicated to the authorized UT/CSD and USBI representatives and the MSFC safety representative and test engineer at least 2 hours in advance.

MSFC Safety Notified JH

UT/CSD Notified JH

5.2 **The MSFC TE will serve as the area coordinator for the test. All handling of the BSM will be directed by the MSFC TE or cognizant test engineer.**

5.3 **Jim McGee (vibration) and Jim Herring (pyro) shall be responsible for photographic coverage of the test activities .**

5.4 **All involved lab directors and division chiefs shall be notified prior to testing.** [✓]

5.5 **The MSFC TE shall make arrangements for the live BSM to be transported from the pyro lab to the vibration lab.** [✓]

5.6 **The area around the outside of the vibration facility shall be secured *before* the live BSM is brought from the pyro shock test site. This area should also be clear so that the transport truck can drive to the vibration lab doors.** [✓]

Area secured? YES NO JH MSFC TE
JMK MSFC SE

Comments: Doors & Gates Secured

6.0 Move BSM from Pyro Shock Area to the Vibration Test Area

6.0.1 Fire symbol 3 shall be used when the motor is in the vibration test rooms. [✓]

9-23-93

GROUNDING.

MOTOR WAS IMMEDIATELY CONNECTED TO THE FACILITY GROUND. (100 FT. STRAP). THE GROUND CONNECTING THE MOTOR TO THE OTHER GROUND (UNDER SHOCK PLATE) WAS DISCONNECTED. THE MOTOR WAS THEN TAKEN TO THE TRUCK. THE STRAP THAT CONNECTED THE MOTOR TO THE GROUND UNDER THE PLATE WAS LEFT CONNECTED AND USED TO CONNECT TO (GROUND) THE TRUCK.

NB 09/22/93
RC 9-22-93
[illegible] 9-22-93

6.1 Take the Test Item to the Vibration Test Room

6.1.1 Have a certified truck ready to transport the test item to the vibration test room. The truck's engine will be turned off and at least one wheel chocked. [✓]

CAUTION: Make New Ground Before Braking Old Ground.

6.1.2 The MSFC TE shall call security (4-4357) to arrange for a motor escort to the vibration lab. [✓]

6.1.3 Attach a ground wire to the truck chassis and verify its resistance. Resistance shall measure less than 1 ohm. SEE OPPOSITE PAGE [✓]

Resistance measured .1 MSFC QA [signature]

CAUTION: Exercise care not to entangle or tug on the motor grounding strap during the following lifting operation.

6.1.4 **SLOWLY** lift the motor and pallet using the certified fork lift and load into the truck bed. Secure the pallet to the truck bed. [✓]

6.1.5 Attach the ground strap from the truck chassis to the motor case. [✓]

Verify resistance between motor case and truck chassis (<1 ohm):

Resistance measured: .1 MSFC QA [signature]

6.1.6 Disconnect the motor to test cell ground. [✓]

6.1.7 Upon arrival of escort , the motor carrying truck and escort personnel shall follow the route provided in Figure 1 moving at a maximum speed of 10 m.p.h. [✓]

6.1.7.1 Fork lift shall proceed to the point designated on Figure 1 as "destination." The fork lift should carry the pallet containing the empty shipping container and place it near the entrance to the longitudinal axis vibration test room. [✓]

6.1.7.2 MSFC TE shall make sure that the necessary hardware and materials are transported to the vibration test room. [✓]

6.1.8 Upon arrival at the destination, the truck will turn off its engine and chock at least one wheel. [✓]

6.1.9 Attach a long ground wire to facility (vib.) ground and verify its resistance. Resistance shall measure less than one (1) ohm. [✓]

Resistance measured: 0.1 MSFC QA [signature]

7-23-93

6.1.10 Attach the free end of this ground wire to the motor and verify its resistance. Resistance shall measure less than one (1) ohm. [✓]

Resistance measured: <1 MSFC QA RC

6.1.11 Remove motor to chassis ground. [✓]

CAUTION: Be careful not to disconnect the ground wires during the following moves.

6.1.12 Use the forklift to place the motor and the pallet directly beneath the overhead crane in room 156, building 4619. [✓]

6.1.13 Disconnect the ground between the fork lift and facility ground. The fork lift may now exit the immediate area. N/A [ ]

FORKLIFT NOT GROUNDED RC 9-22-93 MB 09/22/93 RC 9-22-93

6.1.14 Remove the attach bolts between the support brackets and the pallet. Place the attach bolts in a labeled bag. [✓]

6.1.15 Leave the doors that enter the high bay open while handling the BSM. [✓]

7.0 <u>Thermal Conditioning for Radial Axis Test Setup</u>

7.0.1 Unless otherwise stated by the MSFC TE, all personnel related to this test shall stay in the vibration control room during the test set-up and actual tests. [✓]

7.0.2 <u>Bare Test Fixture Run</u> [✓]

At the discretion of the vibration test supervisor, perform a bare fixture or bare headplate/slipplate equalization run for the first test spectrum in each of the test axes, just prior to mounting the test specimen or after each axis change. This procedure will verify that the vibration control system is set up properly and that the vibration spectrum is within the tolerances specified in paragraph 4.2.1.

Bare fixture run performed: yes ____ no ✓

Comments: Bare fixture run performed before motors brought in

7.1 **Radial Axis Test Setup**

7.1.1 <u>General Information</u>

The vibration control equipment shall be installed as shown in Figure 2, and verify that the equipment calibrations are current. MSFC will provide adapter plates to accommodate the UT/CSD supplied [✓]

9-23-93

test fixture. The BSM will be mounted on the test fixture in the aft motor configuration. Reference Figure 3 for a sketch of this configuration. The motor will be vibrated in each of the three orthogonal axes as shown in Figure 3. The control signal shall be the average of two accelerometers located on the fixture near each bracket/ fixture attach point. Two triaxial response accelerometers shall be attached to the motor near zero degrees at the aft end, and 180 degrees at the forward end, as shown in Figure 3. Accelerometers shall be oriented to the test axes as shown in Figure 3. Hard mount the control accelerometers to the vibration test fixture at the forward and aft attach points and parallel to the direction of excitation. Secure the accelerometer cables to the test fixture with tape. Use an oscilloscope to verify that the noise floor of the vibration control system on the control accelerometer is 0.2 g or less.

7.2 Attach Adapter Plates to the Aft Skirt Support Brackets

7.2.1 Attach the belly straps as shown in Figure 4b for the installation of the adapter plates. [M]✓

CAUTION: The following step involves working with a suspended load. Keep feet and hands out from under the load unless the load is properly blocked up.

CAUTION: Exercise care not to entangle or tug on the motor grounding strap during the following lifting operations.

7.2.2 Lift the test item off the pallet and rotate the motor 180° so that the aft skirt attach bracket mounting holes face up. [✓]

7.2.3 Place the motor on the wood supports. [M]✓

REMINDER: Be sure to put the custom shims in their correct positions and orientation before sliding bolts through the adapter plates.

CAUTION: When using grease, personnel shall wear Neoprene-Latex gloves. Contaminated materials shall be disposed of as hazardous waste.

7.2.4 Place the adapter plates on the BSM brackets and insert the bracket to adapter plate bolts (wet with HD-2 grease) through the brackets and adapter plate. [✓]

7.2.5 Place the appropriate nuts and washers on the bolts but DO NOT torque. [M]✓

9-23-93

7.2.6 Install adapter plate to vibration table fasteners through the adapter plates and secure with wing nuts. [√]

7.2.7 Torque the EWB0420-8-31 bolts (10107-8-31 alternate) with NAS1587-8C washers and TLN1021CPD2-8 self-aligning nuts at "A", "B", and "D" positions (as marked on supports, 6 places) to 605 to 710 in-lbs (51 to 60 ft - lbs) above running torque. At the "C" position, torque the EWB0420-10-32 bolts (10107-10-32 alternate) with NAS1587-10C washers and TLN1023CD3-10 self-aligning nuts (2 places) to 1175 to 1380 in-lbs (98 to 115 ft -lbs) above running torque. Insure that bolt grip is free from the threaded area of nut and that threaded portion of bolt protrudes above nut; if not, use alternate length bolt. [√]

A, B, D torque values: 55 ft-lb MSFC QA RC
C torque value: 105 ft-lb MSFC QA RC

Torque wrench SN: BTW-2RCF
"C" EMJOC 359

CAUTION: Be careful not to disconnect the motor ground while lifting.

CAUTION: The following step involves working with a suspended load. Keep feet and hands out from under the load.

7.2.8 Lift motor off of the wood supports to waist height and rotate 180° so that the bracket mounts are face down. [√]

7.2.9 Remove wing nuts from the adapter plate to vibration table fasteners. [√]

7.3 Position the Test Item Over the Vibration Table Using the Overhead Crane. Align the Test Item With the Proper Holes in the Table. [√]

7.4 Adapter Plate Attachment to the Vibration Table [√]

The adapter plates shall be attached to the vibration table using the fasteners that are normally used by the vibration lab. The fasteners used are 1/2 inch diameter bolts. These bolts should be torqued to 65 foot-pounds.

Record torque value: 65 ft-lbs MSFC QA RC

Torque wrench SN: BTW-2RCF

7.5 Disconnect the lifting straps from the motor and crane. [√]

7.6. CONNECT VIBRATION INSTRUMENTATION AS SHOWN IN FIG. 3. [√]

MB 09/23/93
RJJ 9-23-93
RC 9-23-93

9-23-93

8.0 Thermal Conditioning Setup

General Information:

The BSM motor will be temperature conditioned for a minimum of 24 hours prior to vibration, and shall be maintained at temperature during vibration. The motor will be conditioned to 125 (+5, -0)°F or to 25 (+0, -5)°F.

NOTE: The MSFC TE should mark below which of the two qualification motors pertains to this procedure. The conditioning period starts after the average air temperature inside the conditioning chamber stabilizes at the required temperature. Should the motor be out of conditioning tolerances for greater than 30 minutes, it must be reconditioned for twice the time out of tolerance.

Motor #1 ________°F
Motor SN ________

Motor #2 25 °F
Motor SN 1000734

8.1 Conditioning Chamber Setup for Radial Axis

8.1.1 Use the overhead crane to place the conditioning chamber over the motor. [✓]

8.1.2 Once the chamber is in place, attach the necessary hoses and instrumentation from the conditioning unit to the chamber. [✓]

8.1.3 Make sure the chamber thermocouple is in the correct position for measuring the air temperature around the motor. [✓]

8.1.4 Make sure the motor ground strap is secured. [✓]

8.1.5 Activate conditioning unit and monitor the temperature. The chamber is considered "at temperature" when the temperature has stabilized at the desired value. [✓]

Record time when chamber reached desired value: 11:00 a.m 9/24/93

AC 9-24-93
~~9-23-93~~
9-24-93

9.0 **Post Test Verification**

The procedure delineated in the above document has been satisfactorily completed and :

a. All sequences in the procedure have been completed (or deleted by approved deviation)

b. All Procedure changes have been recorded and approved.

Submitted Verified by: Vi[illegible] Bevill
Test Engineer

Date: 09/24/93

Motor Serial Number: 1000734

9-24-93

Appendix A

Test Procedure Deviation

Figure 1

TEST PROCEDURE DEVIATION		TCP NO.:
TEST ENGINEER:	QUALITY	DATE
REQUIREMENTS ENGINEER:	OTHER:	
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 1

TEST PROCEDURE DEVIATION

TEST PROCEDURE DEVIATION		TCP NO.
EST ENGINEER:	QUALITY	DATE
REQUIREMENTS ENGINEER:	OTHER	
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL.	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 2

DEVIATION LOG

PROCEDURE ____________ REVISION ____________

DEV NO.	PAGE	PARA STEP	REASON/REMARKS	P/T	DATE	
					ISSUED	SIGNED

Appendix B

Figures

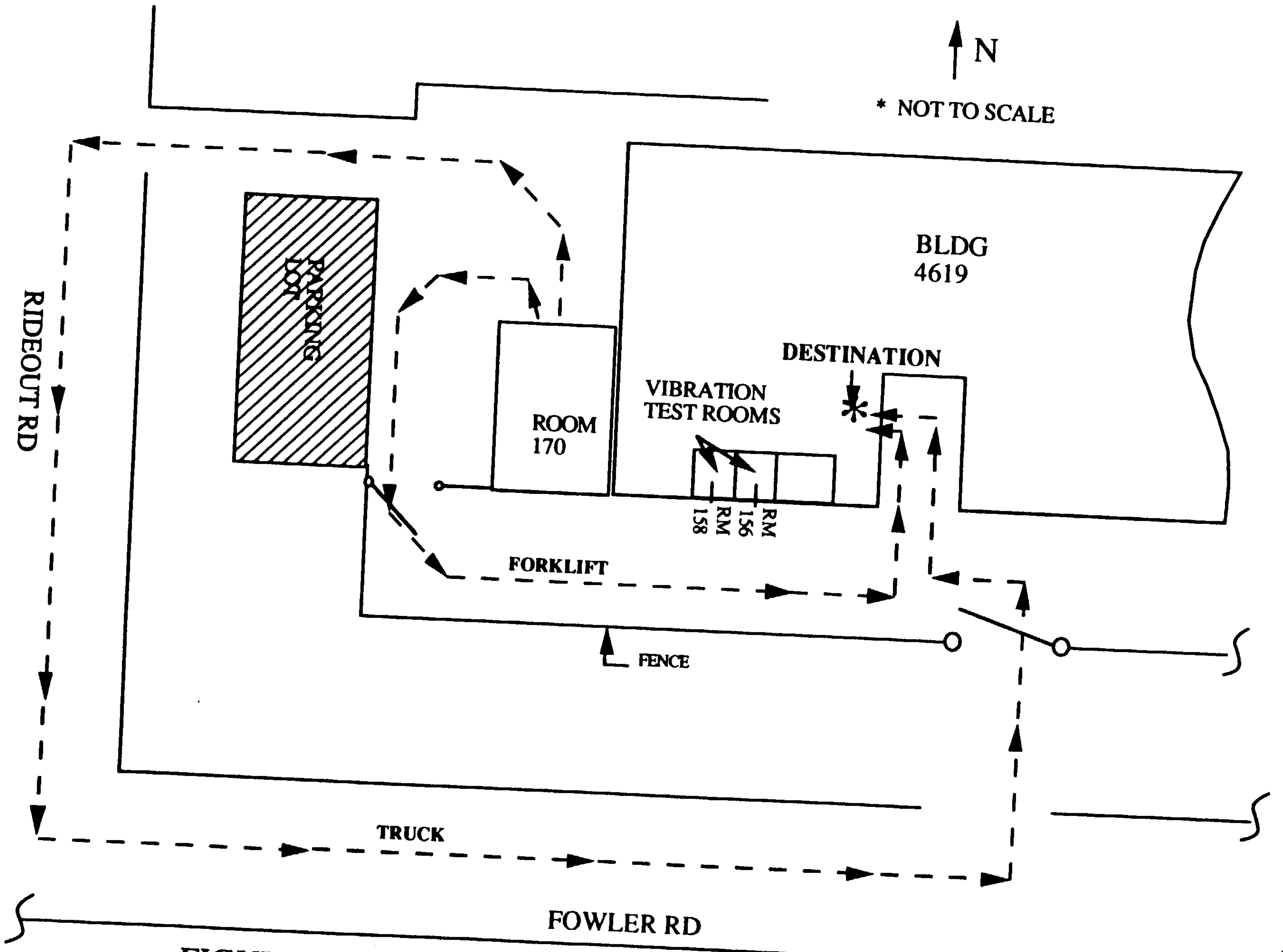


FIGURE 1. TRUCK ROUTE FROM PYRO TO VIBRATION

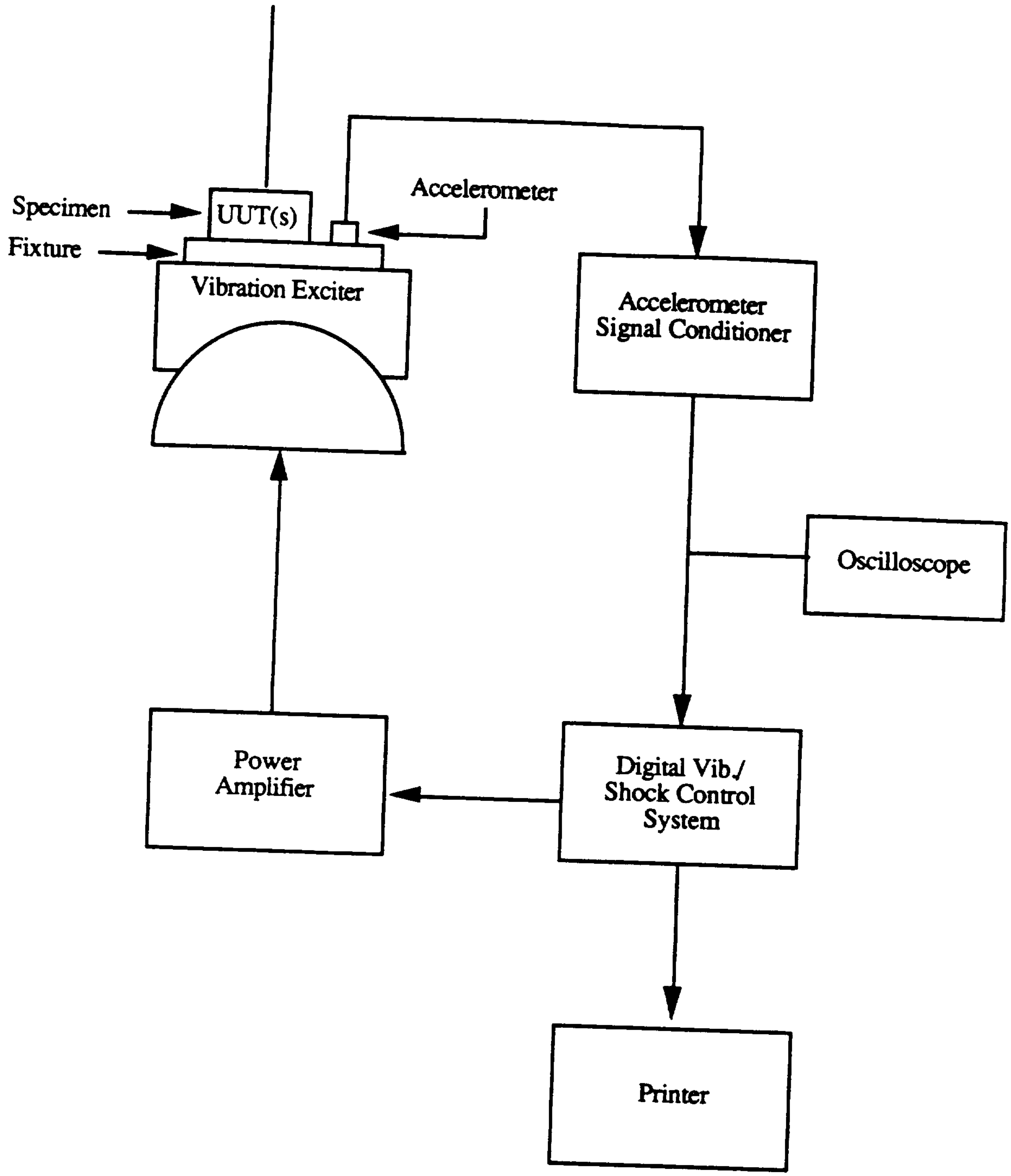
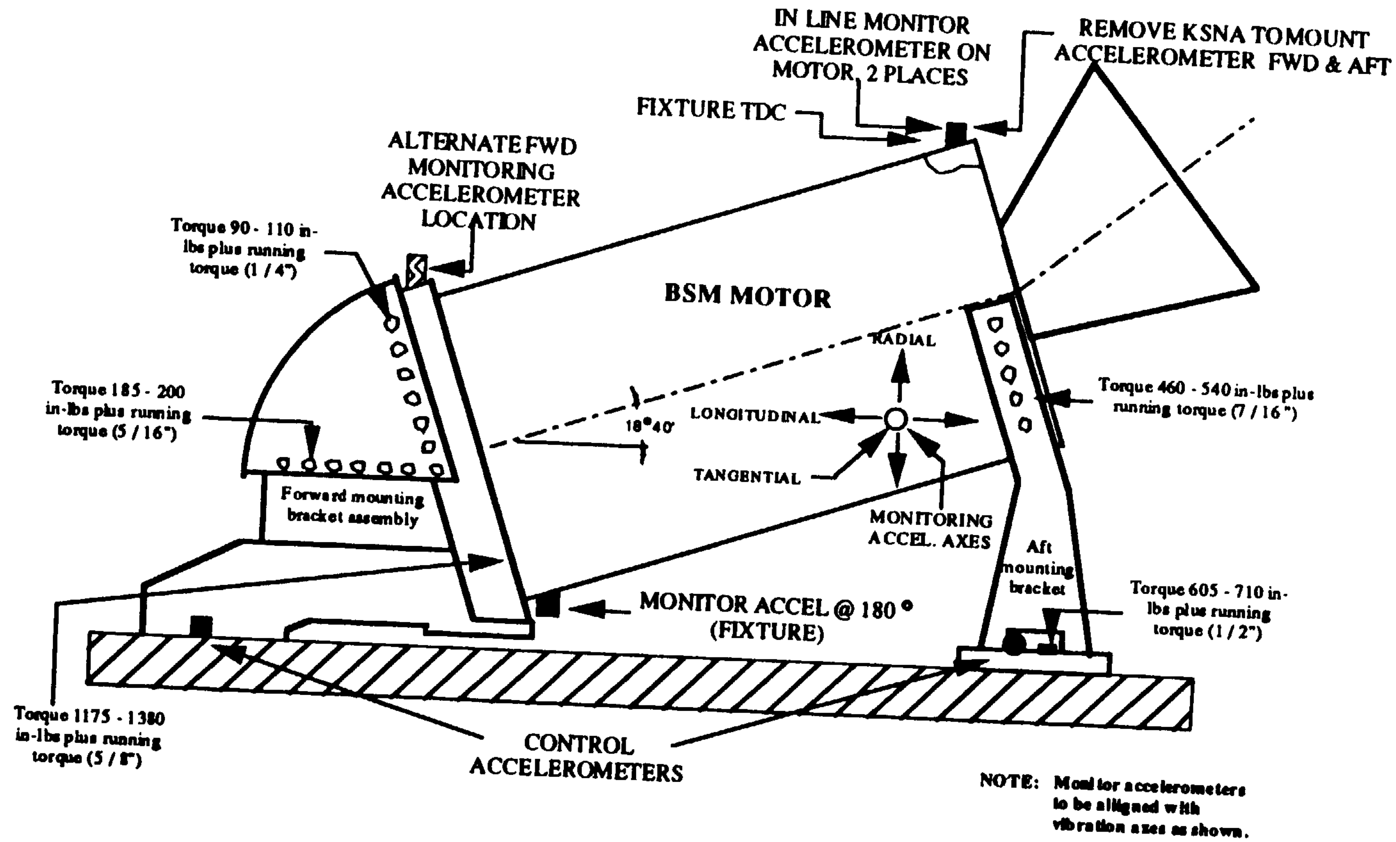


FIGURE 2. BLOCK DIAGRAM OF VIBRATION TEST SETUP

DRAWN BY:
K. MITCHELL/EP54
4/19/93



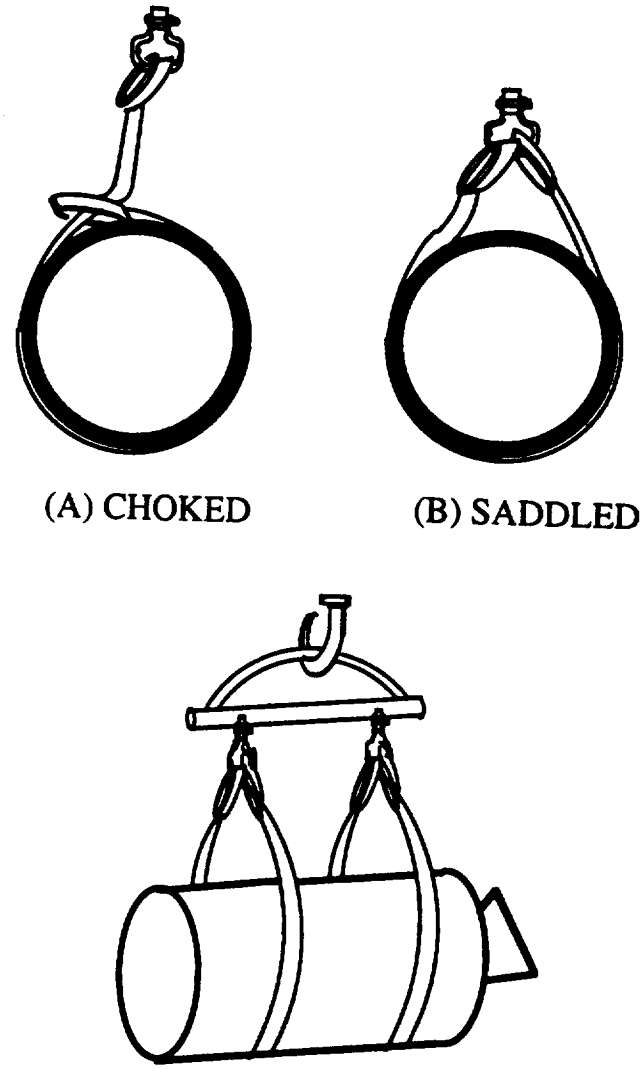
NOTE: Monitor accelerometers to be alligned with vibration axes as shown.

NOTE: If forward monitoring acceleromenter cannot be mounted to the bracket assembly at fixture 180° location, it may be mounted on the bracket at fixture TDC (forward).

FIGURE 3. VIBRATION TEST SETUP

DRAWN BY:
K.MITCHELL/EP54
4/14/93

C-2



(A) CHOKED (B) SADDLED

(C) 3-D IN SADDLED POSITION

FIGURE 4. LIFTING STRAP ATTACHMENTS

DRAWN BY:
K. MITCHELL/EP54
3/8/93

Appendix C

Proof Test Inspection Sheet

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ________________ Date ____________

MSFC Safety ________________ Date ____________

MSFC Quality ________________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. **PCH Identification**
   a. Nomenclature:
   b. SN:

2. **Handling Procedure Number**

3. **Location of Lift (Fac. Bldg.)**
   a. Building: ____________
   b. Date of lift: ____________

4. **Weight to be Lifted (in lbs.)**
   a. Item: ____________
   b. Hoisting Equipment ____________
   c. Total: ____________

5. **Checklist**
   a. Assessment Prior to Critical Lift
      1. Maintenance records ____________
      2. Equipment tagged with appropriate max working loads ____________
      3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
      4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

   b. Operator's Certification Validation:

      Crane ____________ Rigger ____________ Flagman ____________
      Forklift ____________ Driver ____________ Personnel Hoist ____________

   c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

   d. Dummy load lift of ________lbs. completed and no discrepancies noted. ____________

6. **For additional information, observations and remarks**

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

A:\Z001A

MOTOR TEMP. HISTORY for vibration

Thursday October 14, 1993 09:11:54 pm

Booster Separation Motor: SN: 1000734

Temperature: 25 deg. F (+0 deg., -5 deg.)

266 12:51:03
002 75.6 F 003 75.4 F

266 12:53:03
002 75.5 F 003 75.4 F

266 12:55:03
002 75.5 F 003 75.4 F

266 12:57:03
002 75.5 F 003 75.3 F

266 12:59:03
002 75.5 F 003 75.3 F

266 13:01:03
002 75.6 F 003 75.3 F

266 13:03:03
002 75.5 F 003 75.4 F

266 13:05:03
002 75.5 F 003 75.3 F

266 13:07:03
002 75.5 F 003 75.3 F

266 13:09:03
002 75.5 F 003 75.3 F

266 13:11:03
002 75.5 F 003 75.3 F

266 13:13:03
002 75.6 F 003 75.4 F

266 13:15:03
002 75.6 F 003 75.4 F

266 13:17:03
002 75.5 F 003 75.3 F

266 13:19:03
002 75.5 F 003 75.3 F

266 13:21:03
002 75.5 F 003 75.3 F

266 13:23:03
002 75.5 F 003 75.3 F

266 13:25:03

002-****.* F 003-****.* F

266 13:27:03
002-****.* F 003-****.* F

266 13:29:03
002-****.* F 003-****.* F

266 13:31:03
002-****.* F 003-****.* F

266 13:33:03
002-****.* F 003-****.* F

266 13:35:03
002-****.* F 003-****.* F

266 13:37:03
002-****.* F 003-****.* F

266 13:39:03
002-****.* F 003-****.* F

266 13:41:03
002-****.* F 003-****.* F

266 13:43:03
002-****.* F 003-****.* F

266 13:45:03
002-****.* F 003-****.* F

266 13:47:03
002-****.* F 003-****.* F

266 13:49:03
002-****.* F 003-****.* F

266 13:51:03
002-****.* F 003-****.* F

266 13:53:03
002-****.* F 003-****.* F

266 13:55:03
002-****.* F 003-****.* F

266 13:57:03
002-****.* F 003-****.* F

266 13:59:03
002-****.* F 003-****.* F

266 14:01:03
002-****.* F 003-****.* F

266 14:03:03

002-****.* F 003-****.* F

266 14:05:03
002-****.* F 003-****.* F

266 14:07:03
002-****.* F 003-****.* F

266 14:09:03
002-****.* F 003-****.* F

266 14:11:03
002-****.* F 003-****.* F

266 14:13:03
002-****.* F 003-****.* F

266 14:15:03
002-****.* F 003-****.* F

266 14:17:03
002-****.* F 003-****.* F

266 14:19:03
002-****.* F 003-****.* F

266 14:21:03
002-****.* F 003-****.* F

266 14:23:03
002-****.* F 003-****.* F

266 14:25:03
002-****.* F 003-****.* F

266 14:27:03
002-****.* F 003-****.* F

266 14:29:03
002-****.* F 003-****.* F

266 14:31:03
002-****.* F 003-****.* F

266 14:33:03
002-****.* F 003-****.* F

266 14:35:03
002-****.* F 003-****.* F

266 14:37:03
002-****.* F 003-****.* F

266 14:39:03
002-****.* F 003-****.* F

266 14:41:03

002-****.* F 003-****.* F

266 14:43:03
002-****.* F 003-****.* F

266 14:45:03
002-****.* F 003-****.* F

266 14:47:03
002-****.* F 003-****.* F

266 14:49:03
002-****.* F 003-****.* F

266 14:51:03
002-****.* F 003-****.* F

266 14:53:03
002-****.* F 003-****.* F

266 14:55:03
002-****.* F 003-****.* F

266 14:57:03
002-****.* F 003-****.* F

266 14:59:03
002-****.* F 003-****.* F

266 15:01:03
002-****.* F 003-****.* F

266 15:03:03
002-****.* F 003-****.* F

266 15:05:03
002-****.* F 003-****.* F

266 15:07:03
002-****.* F 003-****.* F

266 15:09:03
002-****.* F 003-****.* F

266 15:11:03
002-****.* F 003-****.* F

266 15:13:03
002-****.* F 003-****.* F

266 15:15:03
002-****.* F 003-****.* F

266 15:17:03
002-****.* F 003-****.* F

266 15:19:03

002-****.* F 003-****.* F

266 15:21:03
002-****.* F 003-****.* F

266 15:23:03
002-****.* F 003-****.* F

266 15:25:03
002-****.* F 003-****.* F

266 15:27:03
002-****.* F 003-****.* F

266 15:29:03
002-****.* F 003-****.* F

266 15:31:03
002-****.* F 003-****.* F

266 15:33:03
002-****.* F 003-****.* F

266 15:35:03
002-****.* F 003-****.* F

266 15:37:03
002-****.* F 003-****.* F

266 15:39:03
002-****.* F 003-****.* F

266 15:41:03
002-****.* F 003-****.* F

266 15:43:03
002-****.* F 003-****.* F

266 15:45:03
002-****.* F 003-****.* F

266 15:47:03
002-****.* F 003-****.* F

266 15:49:03
002-****.* F 003-****.* F

266 15:51:03
002-****.* F 003-****.* F

266 15:53:03
002-****.* F 003-****.* F

266 15:55:03
002-****.* F 003-****.* F

266 15:57:03

002-****.* F 003-****.* F

266 15:59:03
002-****.* F 003-****.* F

266 16:01:03
002-****.* F 003-****.* F

266 16:03:03
002-****.* F 003-****.* F

266 16:05:03
002-****.* F 003-****.* F

266 16:07:03
002-****.* F 003-****.* F

266 16:09:03
002-****.* F 003-****.* F

266 16:11:03
002-****.* F 003-****.* F

266 16:13:03
002-****.* F 003-****.* F

266 16:15:03
002-****.* F 003-****.* F

266 16:17:03
002-****.* F 003-****.* F

266 16:19:03
002-****.* F 003-****.* F

266 16:21:03
002-****.* F 003-****.* F

266 16:23:03
002-****.* F 003-****.* F

266 16:25:03
002-****.* F 003-****.* F

266 16:27:03
002-****.* F 003-****.* F

266 16:29:03
002-****.* F 003-****.* F

266 16:31:03
002-****.* F 003-****.* F

266 16:33:03
002-****.* F 003-****.* F

266 16:35:03

002-****.* F 003-****.* F

266 16:37:03
002-****.* F 003-****.* F

266 16:39:03
002-****.* F 003-****.* F

266 16:41:03
002-****.* F 003-****.* F

266 16:43:03
002-****.* F 003-****.* F

266 16:45:03
002-****.* F 003-****.* F

266 16:47:03
002-****.* F 003-****.* F

266 16:49:03
002-****.* F 003-****.* F

266 16:51:03
002-****.* F 003-****.* F

266 16:53:03
002-****.* F 003-****.* F

266 16:55:03
002-****.* F 003-****.* F

266 16:57:03
002-****.* F 003-****.* F

266 16:59:03
002-****.* F 003-****.* F

266 17:01:03
002-****.* F 003-****.* F

266 17:03:03
002-****.* F 003-****.* F

266 17:05:03
002-****.* F 003-****.* F

266 17:07:03
002-****.* F 003-****.* F

266 17:09:03
002-****.* F 003-****.* F

266 17:11:03
002-****.* F 003-****.* F

266 17:13:03

002-****.* F 003-****.* F

266 17:15:03
002-****.* F 003-****.* F

266 17:17:03
002-****.* F 003-****.* F

266 17:19:03
002-****.* F 003-****.* F

266 17:21:03
002-****.* F 003-****.* F

266 17:23:03
002-****.* F 003-****.* F

266 17:25:03
002-****.* F 003-****.* F

266 17:27:03
002-****.* F 003-****.* F

266 17:29:03
002-****.* F 003-****.* F

266 17:31:03
002-****.* F 003-****.* F

266 17:33:03
002-****.* F 003-****.* F

266 17:35:03
002-****.* F 003-****.* F

266 17:37:03
002-****.* F 003-****.* F

266 17:39:03
002-****.* F 003-****.* F

266 17:41:03
002-****.* F 003-****.* F

266 17:43:03
002-****.* F 003-****.* F

266 17:45:03
002-****.* F 003-****.* F

266 17:47:03
002-****.* F 003-****.* F

266 17:49:03
002-****.* F 003-****.* F

266 17:51:03

002-****.* F 003-****.* F

266 17:53:03
002-****.* F 003-****.* F

266 17:55:03
002-****.* F 003-****.* F

266 17:57:03
002-****.* F 003-****.* F

266 17:59:03
002-****.* F 003-****.* F

266 18:01:03
002-****.* F 003-****.* F

266 18:03:03
002-****.* F 003-****.* F

266 18:05:03
002-****.* F 003-****.* F

266 18:07:03
002-****.* F 003-****.* F

266 18:09:03
002-****.* F 003-****.* F

266 18:11:03
002-****.* F 003-****.* F

266 18:13:03
002-****.* F 003-****.* F

266 18:15:03
002-****.* F 003-****.* F

266 18:17:03
002-****.* F 003-****.* F

266 18:19:03
002-****.* F 003-****.* F

266 18:21:03
002-****.* F 003-****.* F

266 18:23:03
002-****.* F 003-****.* F

266 18:25:03
002-****.* F 003-****.* F

266 18:27:03
002-****.* F 003-****.* F

266 18:29:03

002-****.* F 003-****.* F

266 18:31:03
002-****.* F 003-****.* F

266 18:33:03
002-****.* F 003-****.* F

266 18:35:03
002-****.* F 003-****.* F

266 18:37:03
002-****.* F 003-****.* F

266 18:39:03
002-****.* F 003-****.* F

266 18:41:03
002-****.* F 003-****.* F

266 18:43:03
002-****.* F 003-****.* F

266 18:45:03
002-****.* F 003-****.* F

266 18:47:03
002-****.* F 003-****.* F

266 18:49:03
002-****.* F 003-****.* F

266 18:51:03
002-****.* F 003-****.* F

266 18:53:03
002-****.* F 003-****.* F

266 18:55:03
002-****.* F 003-****.* F

266 18:57:03
002-****.* F 003-****.* F

266 18:59:03
002-****.* F 003-****.* F

266 19:01:03
002-****.* F 003-****.* F

266 19:03:03
002-****.* F 003-****.* F

266 19:05:03
002-****.* F 003-****.* F

266 19:07:03

002-****.* F 003-****.* F

266 19:09:03
002-****.* F 003-****.* F

266 19:11:03
002-****.* F 003-****.* F

266 19:13:03
002-****.* F 003-****.* F

266 19:15:03
002-****.* F 003-****.* F

266 19:17:03
002-****.* F 003-****.* F

266 19:19:03
002-****.* F 003-****.* F

266 19:21:03
002-****.* F 003-****.* F

266 19:23:03
002-****.* F 003-****.* F

266 19:25:03
002-****.* F 003-****.* F

266 19:27:03
002-****.* F 003-****.* F

266 19:29:03
002-****.* F 003-****.* F

266 19:31:03
002-****.* F 003-****.* F

266 19:33:03
002-****.* F 003-****.* F

266 19:35:03
002-****.* F 003-****.* F

266 19:37:03
002-****.* F 003-****.* F

266 19:39:03
002-****.* F 003-****.* F

266 19:41:03
002-****.* F 003-****.* F

266 19:43:03
002-****.* F 003-****.* F

266 19:45:03

002-****.* F 003-****.* F

266 19:47:03
002-****.* F 003-****.* F

266 19:49:03
002-****.* F 003-****.* F

266 19:51:03
002-****.* F 003-****.* F

266 19:53:03
002-****.* F 003-****.* F

266 19:55:03
002-****.* F 003-****.* F

266 19:57:03
002-****.* F 003-****.* F

266 19:59:03
002-****.* F 003-****.* F

266 20:01:03
002-****.* F 003-****.* F

266 20:03:03
002-****.* F 003-****.* F

266 20:05:03
002-****.* F 003-****.* F

266 20:07:03
002-****.* F 003-****.* F

266 20:09:03
002-****.* F 003-****.* F

266 20:11:03
002-****.* F 003-****.* F

266 20:13:03
002-****.* F 003-****.* F

266 20:15:03
002-****.* F 003-****.* F

266 20:17:03
002-****.* F 003-****.* F

266 20:19:03
002-****.* F 003-****.* F

266 20:21:03
002-****.* F 003-****.* F

266 20:23:03

002-****.* F 003-****.* F

266 20:25:03
002-****.* F 003-****.* F

266 20:27:03
002-****.* F 003-****.* F

266 20:29:03
002-****.* F 003-****.* F

266 20:31:03
002-****.* F 003-****.* F

266 20:33:03
002-****.* F 003-****.* F

266 20:35:03
002-****.* F 003-****.* F

266 20:37:03
002-****.* F 003-****.* F

266 20:39:03
002-****.* F 003-****.* F

266 20:41:03
002-****.* F 003-****.* F

266 20:43:03
002-****.* F 003-****.* F

266 20:45:03
002-****.* F 003-****.* F

266 20:47:03
002-****.* F 003-****.* F

266 20:49:03
002-****.* F 003-****.* F

266 20:51:03
002-****.* F 003-****.* F

266 20:53:03
002-****.* F 003-****.* F

266 20:55:03
002-****.* F 003-****.* F

266 20:57:03
002-****.* F 003-****.* F

266 20:59:03
002-****.* F 003-****.* F

266 21:01:03

002-****.* F 003-****.* F

266 21:03:03
002-****.* F 003-****.* F

266 21:05:03
002-****.* F 003-****.* F

266 21:07:03
002-****.* F 003-****.* F

266 21:09:03
002-****.* F 003-****.* F

266 21:11:03
002-****.* F 003-****.* F

266 21:13:03
002-****.* F 003-****.* F

266 21:15:03
002-****.* F 003-****.* F

266 21:17:03
002-****.* F 003-****.* F

266 21:19:03
002-****.* F 003-****.* F

266 21:21:03
002-****.* F 003-****.* F

266 21:23:03
002-****.* F 003-****.* F

266 21:25:03
002-****.* F 003-****.* F

266 21:27:03
002-****.* F 003-****.* F

266 21:29:03
002-****.* F 003-****.* F

266 21:31:03
002-****.* F 003-****.* F

266 21:33:03
002-****.* F 003-****.* F

266 21:35:03
002-****.* F 003-****.* F

266 21:37:03
002-****.* F 003-****.* F

266 21:39:03

002-****.* F 003-****.* F

266 21:41:03
002-****.* F 003-****.* F

266 21:43:03
002-****.* F 003-****.* F

266 21:45:03
002-****.* F 003-****.* F

266 21:47:03
002-****.* F 003-****.* F

266 21:49:03
002-****.* F 003-****.* F

266 21:51:03
002-****.* F 003-****.* F

266 21:53:03
002-****.* F 003-****.* F

266 21:55:03
002-****.* F 003-****.* F

266 21:57:03
002-****.* F 003-****.* F

266 21:59:03
002-****.* F 003-****.* F

266 22:01:03
002-****.* F 003-****.* F

266 22:03:03
002-****.* F 003-****.* F

266 22:05:03
002-****.* F 003-****.* F

266 22:07:03
002-****.* F 003-****.* F

266 22:09:03
002-****.* F 003-****.* F

266 22:11:03
002-****.* F 003-****.* F

266 22:13:03
002-****.* F 003-****.* F

266 22:15:03
002-****.* F 003-****.* F

266 22:17:03

002-****.* F 003-****.* F

266 22:19:03
002-****.* F 003-****.* F

266 22:21:03
002-****.* F 003-****.* F

266 22:23:03
002-****.* F 003-****.* F

266 22:25:03
002-****.* F 003-****.* F

266 22:27:03
002-****.* F 003-****.* F

266 22:29:03
002-****.* F 003-****.* F

266 22:31:03
002-****.* F 003-****.* F

266 22:33:03
002-****.* F 003-****.* F

266 22:35:03
002-****.* F 003-****.* F

266 22:37:03
002-****.* F 003-****.* F

266 22:39:03
002-****.* F 003-****.* F

266 22:41:03
002-****.* F 003-****.* F

266 22:43:03
002-****.* F 003-****.* F

266 22:45:03
002-****.* F 003-****.* F

266 22:47:03
002-****.* F 003-****.* F

266 22:49:03
002-****.* F 003-****.* F

266 22:51:03
002-****.* F 003-****.* F

266 22:53:03
002-****.* F 003-****.* F

266 22:55:03

002-****.* F 003-****.* F

266 22:57:03
002-****.* F 003-****.* F

266 22:59:03
002-****.* F 003-****.* F

266 23:01:03
002-****.* F 003-****.* F

266 23:03:03
002-****.* F 003-****.* F

266 23:05:03
002-****.* F 003-****.* F

266 23:07:03
002-****.* F 003-****.* F

266 23:09:03
002-****.* F 003-****.* F

266 23:11:03
002-****.* F 003-****.* F

266 23:13:03
002-****.* F 003-****.* F

266 23:15:03
002-****.* F 003-****.* F

266 23:17:03
002-****.* F 003-****.* F

266 23:19:03
002-****.* F 003-****.* F

266 23:21:03
002-****.* F 003-****.* F

266 23:23:03
002-****.* F 003-****.* F

266 23:25:03
002-****.* F 003-****.* F

266 23:27:03
002-****.* F 003-****.* F

266 23:29:03
002-****.* F 003-****.* F

266 23:31:03
002-****.* F 003-****.* F

266 23:33:03

002-****.* F 003-****.* F

266 23:35:03
002-****.* F 003-****.* F

266 23:37:03
002-****.* F 003-****.* F

266 23:39:03
002-****.* F 003-****.* F

266 23:41:03
002-****.* F 003-****.* F

266 23:43:03
002-****.* F 003-****.* F

266 23:45:03
002-****.* F 003-****.* F

266 23:47:03
002-****.* F 003-****.* F

266 23:49:03
002-****.* F 003-****.* F

266 23:51:03
002-****.* F 003-****.* F

266 23:53:03
002-****.* F 003-****.* F

266 23:55:03
002-****.* F 003-****.* F

266 23:57:03
002-****.* F 003-****.* F

266 23:59:03
002-****.* F 003-****.* F

267 00:01:03
002-****.* F 003-****.* F

267 00:03:03
002-****.* F 003-****.* F

267 00:05:03
002-****.* F 003-****.* F

267 00:07:03
002-****.* F 003-****.* F

267 00:09:03
002-****.* F 003-****.* F

267 00:11:03

002-****.* F 003-****.* F

267 00:13:03
002-****.* F 003-****.* F

267 00:15:03
002-****.* F 003-****.* F

267 00:17:03
002-****.* F 003-****.* F

267 00:19:03
002-****.* F 003-****.* F

267 00:21:03
002-****.* F 003-****.* F

267 00:23:03
002-****.* F 003-****.* F

267 00:25:03
002-****.* F 003-****.* F

267 00:27:03
002-****.* F 003-****.* F

267 00:29:03
002-****.* F 003-****.* F

267 00:31:03
002-****.* F 003-****.* F

267 00:33:03
002-****.* F 003-****.* F

267 00:35:03
002-****.* F 003-****.* F

267 00:37:03
002-****.* F 003-****.* F

267 00:39:03
002-****.* F 003-****.* F

267 00:41:03
002-****.* F 003-****.* F

267 00:43:03
002-****.* F 003-****.* F

267 00:45:03
002-****.* F 003-****.* F

267 00:47:03
002-****.* F 003-****.* F

267 00:49:03

002-****.* F 003-****.* F

267 00:51:03
002-****.* F 003-****.* F

267 00:53:03
002-****.* F 003-****.* F

267 00:55:03
002-****.* F 003-****.* F

267 00:57:03
002-****.* F 003-****.* F

267 00:59:03
002-****.* F 003-****.* F

267 01:01:03
002-****.* F 003-****.* F

267 01:03:03
002-****.* F 003-****.* F

267 01:05:03
002-****.* F 003-****.* F

267 01:07:03
002-****.* F 003-****.* F

267 01:09:03
002-****.* F 003-****.* F

267 01:11:03
002-****.* F 003-****.* F

267 01:13:03
002-****.* F 003-****.* F

267 01:15:03
002-****.* F 003-****.* F

267 01:17:03
002-****.* F 003-****.* F

267 01:19:03
002-****.* F 003-****.* F

267 01:21:03
002-****.* F 003-****.* F

267 01:23:03
002-****.* F 003-****.* F

267 01:25:03
002-****.* F 003-****.* F

267 01:27:03

002-****.* F 003-****.* F

267 01:29:03
002-****.* F 003-****.* F

267 01:31:03
002-****.* F 003-****.* F

267 01:33:03
002-****.* F 003-****.* F

267 01:35:03
002-****.* F 003-****.* F

267 01:37:03
002-****.* F 003-****.* F

267 01:39:03
002-****.* F 003-****.* F

267 01:41:03
002-****.* F 003-****.* F

267 01:43:03
002-****.* F 003-****.* F

267 01:45:03
002-****.* F 003-****.* F

267 01:47:03
002-****.* F 003-****.* F

267 01:49:03
002-****.* F 003-****.* F

267 01:51:03
002-****.* F 003-****.* F

267 01:53:03
002-****.* F 003-****.* F

267 01:55:03
002-****.* F 003-****.* F

267 01:57:03
002-****.* F 003-****.* F

267 01:59:03
002-****.* F 003-****.* F

267 02:01:03
002-****.* F 003-****.* F

267 02:03:03
002-****.* F 003-****.* F

267 02:05:03

002-****.* F 003-****.* F

267 02:07:03
002-****.* F 003-****.* F

267 02:09:03
002-****.* F 003-****.* F

267 02:11:03
002-****.* F 003-****.* F

267 02:13:03
002-****.* F 003-****.* F

267 02:15:03
002-****.* F 003-****.* F

267 02:17:03
002-****.* F 003-****.* F

267 02:19:03
002-****.* F 003-****.* F

267 02:21:03
002-****.* F 003-****.* F

267 02:23:03
002-****.* F 003-****.* F

267 02:25:03
002-****.* F 003-****.* F

267 02:27:03
002-****.* F 003-****.* F

267 02:29:03
002-****.* F 003-****.* F

267 02:31:03
002-****.* F 003-****.* F

267 02:33:03
002-****.* F 003-****.* F

267 02:35:03
002-****.* F 003-****.* F

267 02:37:03
002-****.* F 003-****.* F

267 02:39:03
002-****.* F 003-****.* F

267 02:41:03
002-****.* F 003-****.* F

267 02:43:03

002-****.* F 003-****.* F

267 02:45:03
002-****.* F 003-****.* F

267 02:47:03
002-****.* F 003-****.* F

267 02:49:03
002-****.* F 003-****.* F

267 02:51:03
002-****.* F 003-****.* F

267 02:53:03
002-****.* F 003-****.* F

267 02:55:03
002-****.* F 003-****.* F

267 02:57:03
002-****.* F 003-****.* F

267 02:59:03
002-****.* F 003-****.* F

267 03:01:03
002-****.* F 003-****.* F

267 03:03:03
002-****.* F 003-****.* F

267 03:05:03
002-****.* F 003-****.* F

267 03:07:03
002-****.* F 003-****.* F

267 03:09:03
002-****.* F 003-****.* F

267 03:11:03
002-****.* F 003-****.* F

267 03:13:03
002-****.* F 003-****.* F

267 03:15:03
002-****.* F 003-****.* F

267 03:17:03
002-****.* F 003-****.* F

267 03:19:03
002-****.* F 003-****.* F

267 03:21:03

002-****.* F 003-****.* F

267 03:23:03
002-****.* F 003-****.* F

267 03:25:03
002-****.* F 003-****.* F

267 03:27:03
002-****.* F 003-****.* F

267 03:29:03
002-****.* F 003-****.* F

267 03:31:03
002-****.* F 003-****.* F

267 03:33:03
002-****.* F 003-****.* F

267 03:35:03
002-****.* F 003-****.* F

267 03:37:03
002-****.* F 003-****.* F

267 03:39:03
002-****.* F 003-****.* F

267 03:41:03
002-****.* F 003-****.* F

267 03:43:03
002-****.* F 003-****.* F

267 03:45:03
002-****.* F 003-****.* F

267 03:47:03
002-****.* F 003-****.* F

267 03:49:03
002-****.* F 003-****.* F

267 03:51:03
002-****.* F 003-****.* F

267 03:53:03
002-****.* F 003-****.* F

267 03:55:03
002-****.* F 003-****.* F

267 03:57:03
002-****.* F 003-****.* F

267 03:59:03

002-****.* F 003-****.* F

267 04:01:03
002-****.* F 003-****.* F

267 04:03:03
002-****.* F 003-****.* F

267 04:05:03
002-****.* F 003-****.* F

267 04:07:03
002-****.* F 003-****.* F

267 04:09:03
002-****.* F 003-****.* F

267 04:11:03
002-****.* F 003-****.* F

267 04:13:03
002-****.* F 003-****.* F

267 04:15:03
002-****.* F 003-****.* F

267 04:17:03
002-****.* F 003-****.* F

267 04:19:03
002-****.* F 003-****.* F

267 04:21:03
002-****.* F 003-****.* F

267 04:23:03
002-****.* F 003-****.* F

267 04:25:03
002-****.* F 003-****.* F

267 04:27:03
002-****.* F 003-****.* F

267 04:29:03
002-****.* F 003-****.* F

267 04:31:03
002-****.* F 003-****.* F

267 04:33:03
002-****.* F 003-****.* F

267 04:35:03
002-****.* F 003-****.* F

267 04:37:03

002-****.* F 003-****.* F

267 04:39:03
002-****.* F 003-****.* F

267 04:41:03
002-****.* F 003-****.* F

267 04:43:03
002-****.* F 003-****.* F

267 04:45:03
002-****.* F 003-****.* F

267 04:47:03
002-****.* F 003-****.* F

267 04:49:03
002-****.* F 003-****.* F

267 04:51:03
002-****.* F 003-****.* F

267 04:53:03
002-****.* F 003-****.* F

267 04:55:03
002-****.* F 003-****.* F

267 04:57:03
002-****.* F 003-****.* F

267 04:59:03
002-****.* F 003-****.* F

267 05:01:03
002-****.* F 003-****.* F

267 05:03:03
002-****.* F 003-****.* F

267 05:05:03
002-****.* F 003-****.* F

267 05:07:03
002-****.* F 003-****.* F

267 05:09:03
002-****.* F 003-****.* F

267 05:11:03
002-****.* F 003-****.* F

267 05:13:03
002-****.* F 003-****.* F

267 05:15:03

002-****.* F 003-****.* F

267 05:17:03
002-****.* F 003-****.* F

267 05:19:03
002-****.* F 003-****.* F

267 05:21:03
002-****.* F 003-****.* F

267 05:23:03
002-****.* F 003-****.* F

267 05:25:03
002-****.* F 003-****.* F

267 05:27:03
002-****.* F 003-****.* F

267 05:29:03
002-****.* F 003-****.* F

267 05:31:03
002-****.* F 003-****.* F

267 05:33:03
002-****.* F 003-****.* F

267 05:35:03
002-****.* F 003-****.* F

267 05:37:03
002-****.* F 003-****.* F

267 05:39:03
002-****.* F 003-****.* F

267 05:41:03
002-****.* F 003-****.* F

267 05:43:03
002-****.* F 003-****.* F

267 05:45:03
002-****.* F 003-****.* F

267 05:47:03
002-****.* F 003-****.* F

267 05:49:03
002-****.* F 003-****.* F

267 05:51:03
002-****.* F 003-****.* F

267 05:53:03

002-****.* F 003-****.* F

267 05:55:03
002-****.* F 003-****.* F

267 05:57:03
002-****.* F 003-****.* F

267 05:59:03
002-****.* F 003-****.* F

267 06:01:03
002-****.* F 003-****.* F

267 06:03:03
002-****.* F 003-****.* F

267 06:05:03
002-****.* F 003-****.* F

267 06:07:03
002-****.* F 003-****.* F

267 06:09:03
002-****.* F 003-****.* F

267 06:11:03
002-****.* F 003-****.* F

267 06:13:03
002-****.* F 003-****.* F

267 06:15:03
002-****.* F 003-****.* F

267 06:17:03
002-****.* F 003-****.* F

267 06:19:03
002-****.* F 003-****.* F

267 06:21:03
002-****.* F 003-****.* F

267 06:23:03
002-****.* F 003-****.* F

267 06:25:03
002-****.* F 003-****.* F

267 06:27:03
002-****.* F 003-****.* F

267 06:29:03
002-****.* F 003-****.* F

267 06:31:03

002-****.* F 003-****.* F

267 06:33:03
002-****.* F 003-****.* F

267 06:35:03
002-****.* F 003-****.* F

267 06:37:03
002-****.* F 003-****.* F

267 06:39:03
002-****.* F 003-****.* F

267 06:41:03
002-****.* F 003-****.* F

267 06:43:03
002-****.* F 003-****.* F

267 06:45:03
002-****.* F 003-****.* F

267 06:47:03
002-****.* F 003-****.* F

267 06:49:03
002-****.* F 003-****.* F

267 06:51:03
002-****.* F 003-****.* F

267 06:53:03
002-****.* F 003-****.* F

267 06:55:03
002-****.* F 003-****.* F

267 06:57:03
002-****.* F 003-****.* F

267 06:59:03
002-****.* F 003-****.* F

267 07:01:03
002-****.* F 003-****.* F

267 07:03:03
002-****.* F 003-****.* F

267 07:05:03
002-****.* F 003-****.* F

267 07:07:03
002-****.* F 003-****.* F

267 07:09:03

002-****.* F 003-****.* F

267 07:11:03
002-****.* F 003-****.* F

267 07:13:03
002-****.* F 003-****.* F

267 07:15:03
002-****.* F 003-****.* F

267 07:17:03
002-****.* F 003-****.* F

267 07:19:03
002-****.* F 003-****.* F

267 07:21:03
002-****.* F 003-****.* F

267 07:23:03
002-****.* F 003-****.* F

267 07:25:03
002-****.* F 003-****.* F

267 07:27:03
002-****.* F 003-****.* F

267 07:29:03
002-****.* F 003-****.* F

267 07:31:03
002-****.* F 003-****.* F

267 07:33:03
002-****.* F 003-****.* F

267 07:35:03
002-****.* F 003-****.* F

267 07:37:03
002-****.* F 003-****.* F

267 07:39:03
002-****.* F 003-****.* F

267 07:41:03
002-****.* F 003-****.* F

267 07:43:03
002-****.* F 003-****.* F

267 07:45:03
002-****.* F 003-****.* F

267 07:47:03

002-****.* F 003-****.* F

267 07:49:03
002-****.* F 003-****.* F

267 07:51:03
002-****.* F 003-****.* F

267 07:53:03
002-****.* F 003-****.* F

267 07:55:03
002-****.* F 003-****.* F

267 07:57:03
002-****.* F 003-****.* F

267 07:59:03
002-****.* F 003-****.* F

267 08:01:03
002-****.* F 003-****.* F

267 08:03:03
002-****.* F 003-****.* F

267 08:05:03
002-****.* F 003-****.* F

267 08:07:03
002-****.* F 003-****.* F

267 08:09:03
002-****.* F 003-****.* F

267 08:11:03
002-****.* F 003-****.* F

267 08:13:03
002-****.* F 003-****.* F

267 08:15:03
002-****.* F 003-****.* F

267 08:17:03
002-****.* F 003-****.* F

267 08:19:03
002-****.* F 003-****.* F

267 08:21:03
002-****.* F 003-****.* F

267 08:23:03
002-****.* F 003-****.* F

267 08:25:03

002-****.* F 003-****.* F

267 08:27:03
002-****.* F 003-****.* F

267 08:29:03
002-****.* F 003-****.* F

267 08:31:03
002-****.* F 003-****.* F

267 08:33:03
002-****.* F 003-****.* F

267 08:35:03
002-****.* F 003-****.* F

267 08:37:03
002-****.* F 003-****.* F

267 08:39:03
002 67.9 F 003 68.2 F

267 08:41:03
002 67.9 F 003 68.2 F

267 08:43:03
002 68.0 F 003 68.2 F

267 08:45:03
002 68.1 F 003 68.3 F

267 08:47:03
002 68.1 F 003 68.2 F

267 08:49:03
002 68.2 F 003 68.3 F

267 08:51:03
002 68.2 F 003 68.3 F

267 08:53:03
002 67.4 F 003 67.4 F

267 08:55:03
002 66.0 F 003 66.3 F

267 08:57:03
002 61.6 F 003 62.6 F

267 08:59:03
002 54.0 F 003 54.7 F

267 09:01:03
002 55.0 F 003 55.3 F

267 09:03:03

002 50.9 F 003 51.7 F

267 09:05:03
002 49.1 F 003 49.7 F

267 09:07:03
002 49.3 F 003 49.7 F

267 09:09:03
002 47.2 F 003 47.9 F

267 09:11:03
002 45.0 F 003 45.6 F

267 09:13:03
002 43.5 F 003 44.0 F

267 09:15:03
002 42.6 F 003 43.1 F

267 09:17:03
002 42.0 F 003 42.5 F

267 09:19:03
002 41.5 F 003 42.0 F

267 09:21:03
002 41.5 F 003 41.7 F

267 09:23:03
002 40.1 F 003 40.7 F

267 09:25:03
002 39.6 F 003 40.1 F

267 09:27:03
002 39.3 F 003 39.6 F

267 09:29:03
002 38.7 F 003 39.3 F

267 09:31:03
002 38.8 F 003 38.9 F

267 09:33:03
002 37.7 F 003 38.1 F

267 09:35:03
002 36.9 F 003 37.3 F

267 09:37:03
002 36.5 F 003 36.8 F

267 09:39:03
002 36.4 F 003 36.7 F

267 09:41:03

002 34.7 F 003 35.4 F

267 09:43:03
002 34.3 F 003 34.6 F

267 09:45:03
002 33.8 F 003 34.1 F

267 09:47:03
002 33.5 F 003 33.7 F

267 09:49:03
002 33.1 F 003 33.4 F

267 09:51:03
002 33.0 F 003 33.2 F

267 09:53:03
002 33.0 F 003 32.9 F

267 09:55:03
002 32.5 F 003 32.7 F

267 09:57:03
002 31.0 F 003 31.4 F

267 09:59:03
002 30.1 F 003 30.6 F

267 10:01:03
002 30.2 F 003 30.3 F

267 10:03:03
002 29.6 F 003 30.0 F

267 10:05:03
002 29.9 F 003 29.7 F

267 10:07:03
002 29.5 F 003 29.7 F

267 10:09:03
002 29.3 F 003 29.2 F

267 10:11:03
002 29.0 F 003 29.1 F

267 10:13:03
002 28.4 F 003 28.5 F

267 10:15:03
002 28.1 F 003 28.2 F

267 10:17:03
002 28.1 F 003 28.2 F

267 10:19:03

002 28.1 F 003 28.0 F

267 10:21:03
002 27.5 F 003 27.7 F

267 10:23:03
002 27.5 F 003 27.6 F

267 10:25:03
002 27.5 F 003 27.3 F

267 10:27:03
002 27.0 F 003 27.2 F

267 10:29:03
002 27.1 F 003 27.1 F

267 10:31:03
002 27.1 F 003 27.1 F

267 10:33:03
002 26.7 F 003 26.8 F

267 10:35:03
002 26.9 F 003 26.8 F

267 10:37:03
002 26.4 F 003 26.4 F

267 10:39:03
002 26.2 F 003 26.4 F

267 10:41:03
002 26.3 F 003 26.1 F

267 10:43:03
002 26.0 F 003 26.1 F

267 10:45:03
002 26.0 F 003 26.0 F

267 10:47:03
002 25.6 F 003 25.8 F

267 10:49:03
002 25.6 F 003 25.6 F

267 10:51:03
002 25.7 F 003 25.6 F

267 10:53:03
002 25.3 F 003 25.2 F

267 10:55:03
002 25.3 F 003 25.2 F

267 10:57:03

002 25.0 F 003 25.1 F

267 10:59:03
002 25.0 F 003 24.9 F

267 11:01:03
002 24.9 F 003 24.6 F

267 11:03:03
002 24.5 F 003 24.4 F

267 11:05:03
002 24.2 F 003 24.2 F

267 11:07:03
002 24.1 F 003 24.2 F

267 11:09:03
002 24.1 F 003 24.0 F

267 11:11:03
002 24.0 F 003 23.9 F

267 11:13:03
002 23.6 F 003 23.8 F

267 11:15:03
002 23.8 F 003 23.6 F

267 11:17:03
002 23.7 F 003 23.7 F

267 11:19:03
002 23.6 F 003 23.6 F

267 11:21:03
002 23.3 F 003 23.5 F

267 11:23:03
002 23.4 F 003 23.3 F

267 11:25:03
002 23.3 F 003 23.3 F

267 11:27:03
002 23.4 F 003 23.2 F

267 11:29:03
002 23.0 F 003 23.0 F

267 11:31:03
002 23.1 F 003 23.0 F

267 11:33:03
002 22.8 F 003 23.0 F

267 11:35:03

002 23.1 F 003 22.9 F

267 11:37:03
002 23.2 F 003 23.0 F

267 11:39:03
002 23.1 F 003 22.9 F

267 11:41:03
002 23.0 F 003 22.7 F

267 11:43:03
002 22.6 F 003 22.6 F

267 11:45:03
002 22.4 F 003 22.5 F

267 11:47:03
002 23.0 F 003 22.6 F

267 11:49:03
002 22.7 F 003 22.7 F

267 11:51:03
002 22.9 F 003 22.8 F

267 11:53:03
002 22.9 F 003 22.7 F

267 11:55:03
002 22.6 F 003 22.6 F

267 11:57:03
002 22.7 F 003 22.6 F

267 11:59:03
002 22.5 F 003 22.5 F

267 12:01:03
002 22.7 F 003 22.5 F

267 12:03:03
002 22.6 F 003 22.4 F

267 12:05:03
002 22.4 F 003 22.3 F

267 12:07:03
002 22.4 F 003 22.3 F

267 12:09:03
002 22.3 F 003 22.3 F

267 12:11:03
002 22.3 F 003 22.3 F

267 12:13:03

002 22.4 F 003 22.4 F

267 12:15:03
002 22.4 F 003 22.4 F

267 12:17:03
002 22.5 F 003 22.4 F

267 12:19:03
002 22.5 F 003 22.5 F

267 12:21:03
002 22.2 F 003 22.2 F

267 12:23:03
002 22.4 F 003 22.3 F

267 12:25:03
002 22.5 F 003 22.1 F

267 12:27:03
002 22.4 F 003 22.3 F

267 12:29:03
002 22.4 F 003 22.3 F

267 12:31:03
002 22.6 F 003 22.3 F

267 12:33:03
002 22.5 F 003 22.3 F

267 12:35:03
002 22.4 F 003 22.2 F

267 12:37:03
002 22.3 F 003 22.3 F

267 12:39:03
002 22.3 F 003 22.2 F

267 12:41:03
002 22.5 F 003 22.3 F

267 12:43:03
002 22.4 F 003 22.2 F

267 12:45:03
002 22.4 F 003 22.1 F

267 12:47:03
002 22.2 F 003 22.2 F

267 12:49:03
002 22.4 F 003 22.2 F

267 12:51:03

002 22.2 F 003 22.1 F

267 12:53:03
002 22.2 F 003 22.1 F

267 12:55:03
002 22.3 F 003 22.0 F

267 12:57:03
002 22.0 F 003 22.0 F

267 12:59:03
002 21.9 F 003 21.8 F

267 13:01:03
002 22.0 F 003 21.8 F

267 13:03:03
002 21.9 F 003 21.8 F

267 13:05:03
002 21.8 F 003 21.7 F

267 13:07:03
002 21.8 F 003 21.7 F

267 13:09:03
002 21.9 F 003 21.6 F

267 13:11:03
002 21.9 F 003 21.8 F

267 13:13:03
002 21.9 F 003 21.8 F

267 13:15:03
002 21.9 F 003 21.8 F

267 13:17:03
002 21.8 F 003 21.7 F

267 13:19:03
002 21.7 F 003 21.6 F

267 13:21:03
002 21.7 F 003 21.6 F

267 13:23:03
002 21.7 F 003 21.6 F

267 13:25:03
002 21.7 F 003 21.4 F

267 13:27:03
002 21.7 F 003 21.4 F

267 13:29:03

002 21.7 F 003 21.5 F

267 13:31:03
002 21.7 F 003 21.5 F

267 13:33:03
002 21.5 F 003 21.4 F

267 13:35:03
002 21.6 F 003 21.3 F

267 13:37:03
002 21.5 F 003 21.3 F

267 13:39:03
002 21.4 F 003 21.3 F

267 13:41:03
002 21.4 F 003 21.2 F

267 13:43:03
002 21.7 F 003 21.4 F

267 13:45:03
002 21.4 F 003 21.2 F

267 13:47:03
002 21.4 F 003 21.2 F

267 13:49:03
002 21.5 F 003 21.2 F

267 13:51:03
002 21.3 F 003 21.2 F

267 13:53:03
002 21.2 F 003 21.1 F

267 13:55:03
002 21.3 F 003 21.2 F

267 13:57:03
002 21.2 F 003 21.2 F

267 13:59:03
002 21.2 F 003 21.2 F

267 14:01:03
002 21.2 F 003 21.1 F

267 14:03:03
002 21.4 F 003 21.2 F

267 14:05:03
002 21.6 F 003 21.5 F

267 14:07:03

002 21.8 F 003 21.5 F

267 14:09:03
002 21.7 F 003 21.5 F

267 14:11:03
002 21.6 F 003 21.5 F

267 14:13:03
002 21.7 F 003 21.5 F

267 14:15:03
002 21.5 F 003 21.4 F

267 14:17:03
002 22.0 F 003 21.6 F

267 14:19:03
002 21.8 F 003 21.6 F

267 14:21:03
002 21.8 F 003 21.6 F

267 14:23:03
002 21.6 F 003 21.4 F

267 14:25:03
002 22.0 F 003 21.7 F

267 14:27:03
002 21.7 F 003 21.5 F

267 14:29:03
002 21.7 F 003 21.4 F

267 14:31:03
002 21.8 F 003 21.6 F

267 14:33:03
002 21.6 F 003 21.5 F

267 14:35:03
002 21.7 F 003 21.6 F

267 14:37:03
002 21.9 F 003 21.6 F

267 14:39:03
002 21.8 F 003 21.5 F

267 14:41:03
002 21.8 F 003 21.6 F

267 14:43:03
002 21.7 F 003 21.5 F

267 14:45:03

002 21.6 F 003 21.4 F

267 14:47:03
002 21.8 F 003 21.5 F

267 14:49:03
002 21.6 F 003 21.4 F

267 14:51:03
002 21.5 F 003 21.3 F

267 14:53:03
002 21.7 F 003 21.4 F

267 14:55:03
002 21.7 F 003 21.4 F

267 14:57:03
002 21.4 F 003 21.3 F

267 14:59:03
002 21.6 F 003 21.4 F

267 15:01:03
002 21.4 F 003 21.3 F

267 15:03:03
002 21.6 F 003 21.3 F

267 15:05:03
002 21.4 F 003 21.3 F

267 15:07:03
002 21.6 F 003 21.2 F

267 15:09:03
002 21.8 F 003 21.5 F

267 15:11:03
002 21.6 F 003 21.5 F

267 15:13:03
002 21.7 F 003 21.5 F

267 15:15:03
002 21.8 F 003 21.5 F

267 15:17:03
002 21.6 F 003 21.5 F

267 15:19:03
002 21.7 F 003 21.4 F

267 15:21:03
002 21.5 F 003 21.4 F

267 15:23:03

002 21.5 F 003 21.2 F

267 15:25:03
002 21.5 F 003 21.4 F

267 15:27:03
002 22.0 F 003 21.7 F

267 15:29:03
002 22.0 F 003 21.9 F

267 15:31:03
002 21.8 F 003 21.7 F

267 15:33:03
002 22.2 F 003 21.8 F

267 15:35:03
002 22.1 F 003 21.8 F

267 15:37:03
002 21.9 F 003 21.7 F

267 15:39:03
002 22.0 F 003 21.8 F

267 15:41:03
002 22.1 F 003 21.8 F

267 15:43:03
002 22.0 F 003 21.9 F

267 15:45:03
002 22.0 F 003 21.9 F

267 15:47:03
002 22.2 F 003 21.9 F

267 15:49:03
002 22.2 F 003 22.0 F

267 15:51:03
002 22.0 F 003 21.9 F

267 15:53:03
002 22.1 F 003 21.9 F

267 15:55:03
002 22.2 F 003 21.9 F

267 15:57:03
002 22.1 F 003 21.8 F

267 15:59:03
002 22.1 F 003 21.9 F

267 16:01:03

002 22.0 F 003 21.8 F

267 16:03:03
002 21.9 F 003 21.7 F

267 16:05:03
002 22.1 F 003 21.8 F

267 16:07:03
002 22.0 F 003 21.8 F

267 16:09:03
002 22.1 F 003 21.8 F

267 16:11:03
002 22.0 F 003 21.9 F

267 16:13:03
002 22.0 F 003 21.8 F

267 16:15:03
002 22.1 F 003 21.8 F

267 16:17:03
002 22.1 F 003 21.8 F

267 16:19:03
002 21.9 F 003 21.8 F

267 16:21:03
002 21.8 F 003 21.6 F

267 16:23:03
002 21.9 F 003 21.7 F

267 16:25:03
002 21.9 F 003 21.6 F

267 16:27:03
002 21.9 F 003 21.7 F

267 16:29:03
002 22.1 F 003 21.8 F

267 16:31:03
002 22.0 F 003 21.8 F

267 16:33:03
002 22.0 F 003 21.9 F

267 16:35:03
002 22.1 F 003 21.9 F

267 16:37:03
002 22.0 F 003 21.8 F

267 16:39:03

002 22.2 F 003 21.8 F

267 16:41:03
002 22.3 F 003 21.9 F

267 16:43:03
002 22.2 F 003 21.9 F

267 16:45:03
002 22.1 F 003 21.8 F

267 16:47:03
002 22.3 F 003 21.9 F

267 16:49:03
002 22.2 F 003 22.0 F

267 16:51:03
002 22.1 F 003 21.9 F

267 16:53:03
002 22.2 F 003 21.9 F

267 16:55:03
002 22.4 F 003 22.1 F

267 16:57:03
002 22.2 F 003 22.1 F

267 16:59:03
002 22.4 F 003 22.1 F

267 17:01:03
002 22.3 F 003 22.2 F

267 17:03:03
002 22.4 F 003 22.2 F

267 17:05:03
002 22.8 F 003 22.6 F

267 17:07:03
002 23.0 F 003 22.8 F

267 17:09:03
002 24.1 F 003 23.7 F

267 17:11:03
002 25.7 F 003 25.2 F

267 17:13:03
002 28.2 F 003 27.7 F

267 17:15:03
002 30.4 F 003 29.9 F

267 17:17:03

002 32.0 F 003 31.6 F

267 17:19:03
002 33.1 F 003 32.8 F

267 17:21:03
002 31.4 F 003 31.8 F

267 17:23:03
002 24.2 F 003 24.4 F

267 17:25:03
002 23.7 F 003 23.7 F

267 17:27:03
002 23.1 F 003 23.0 F

267 17:29:03
002 22.5 F 003 22.5 F

267 17:31:03
002 22.5 F 003 22.3 F

267 17:33:03
002 22.1 F 003 22.1 F

267 17:35:03
002 22.1 F 003 22.2 F

267 17:37:03
002 22.0 F 003 21.8 F

267 17:39:03
002 22.0 F 003 21.8 F

267 17:41:03
002 22.0 F 003 21.8 F

267 17:43:03
002 22.0 F 003 21.8 F

267 17:45:03
002 21.9 F 003 21.8 F

267 17:47:03
002 22.0 F 003 21.8 F

267 17:49:03
002 21.8 F 003 21.7 F

267 17:51:03
002 21.8 F 003 21.6 F

267 17:53:03
002 21.9 F 003 21.6 F

267 17:55:03

002 21.8 F 003 21.6 F

267 17:57:03
002 21.7 F 003 21.5 F

267 17:59:03
002 21.8 F 003 21.5 F

267 18:01:03
002 21.7 F 003 21.5 F

267 18:03:03
002 21.7 F 003 21.4 F

267 18:05:03
002 21.7 F 003 21.4 F

267 18:07:03
002 21.6 F 003 21.4 F

267 18:09:03
002 21.6 F 003 21.4 F

267 18:11:03
002 21.7 F 003 21.4 F

267 18:13:03
002 21.6 F 003 21.3 F

267 18:15:03
002 21.7 F 003 21.4 F

267 18:17:03
002 21.5 F 003 21.4 F

267 18:19:03
002 21.5 F 003 21.4 F

267 18:21:03
002 21.7 F 003 21.5 F

267 18:23:03
002 21.8 F 003 21.6 F

267 18:25:03
002 21.9 F 003 21.5 F

267 18:27:03
002 21.7 F 003 21.6 F

267 18:29:03
002 21.7 F 003 21.5 F

267 18:31:03
002 22.0 F 003 21.8 F

267 18:33:03

002 22.0 F 003 21.8 F

267 18:35:03
002 22.1 F 003 21.9 F

267 18:37:03
002 22.6 F 003 22.1 F

267 18:39:03
002 22.7 F 003 22.4 F

267 18:41:03
002 22.7 F 003 22.5 F

267 18:43:03
002 22.7 F 003 22.6 F

267 18:45:03
002 22.8 F 003 22.6 F

267 18:47:03
002 22.9 F 003 22.6 F

267 18:49:03
002 22.8 F 003 22.6 F

267 18:51:03
002 22.7 F 003 22.5 F

267 18:53:03
002 22.7 F 003 22.6 F

267 18:55:03
002 22.8 F 003 22.7 F

267 18:57:03
002 22.7 F 003 22.6 F

267 18:59:03
002 22.7 F 003 22.6 F

267 19:01:03
002 23.0 F 003 22.6 F

267 19:03:03
002 22.8 F 003 22.6 F

267 19:05:03
002 22.9 F 003 22.7 F

267 19:07:03
002 22.7 F 003 22.5 F

267 19:09:03
002 22.4 F 003 22.3 F

267 19:11:03

002 22.6 F 003 22.4 F
267 19:13:03
002 22.5 F 003 22.3 F
267 19:15:03
002 22.5 F 003 22.3 F
267 19:17:03
002 22.5 F 003 22.3 F
267 19:19:03
002 22.4 F 003 22.3 F
267 19:21:03
002 22.5 F 003 22.3 F
267 19:23:03
002 22.5 F 003 22.3 F
267 19:25:03
002 22.4 F 003 22.3 F
267 19:27:03
002 22.5 F 003 22.3 F
267 19:29:03
002 22.6 F 003 22.4 F
267 19:31:03
002 22.3 F 003 22.3 F
267 19:33:03
002 22.5 F 003 22.4 F
267 19:35:03
002 22.4 F 003 22.3 F
267 19:37:03
002 22.5 F 003 22.3 F
267 19:39:03
002 22.6 F 003 22.4 F
267 19:41:03
002 22.4 F 003 22.3 F
267 19:43:03
002 22.5 F 003 22.2 F
267 19:45:03
002 22.5 F 003 22.4 F
267 19:47:03
002 22.3 F 003 22.3 F
267 19:49:03

002 22.6 F 003 22.5 F

267 19:51:03
002 22.6 F 003 22.4 F

267 19:53:03
002 22.7 F 003 22.4 F

267 19:55:03
002 22.5 F 003 22.4 F

267 19:57:03
002 22.4 F 003 22.3 F

267 19:59:03
002 22.3 F 003 22.3 F

267 20:01:03
002 22.6 F 003 22.4 F

267 20:03:03
002 22.4 F 003 22.3 F

267 20:05:03
002 22.5 F 003 22.5 F

267 20:07:03
002 22.5 F 003 22.4 F

267 20:09:03
002 22.3 F 003 22.4 F

267 20:11:03
002 22.4 F 003 22.4 F

267 20:13:03
002 22.5 F 003 22.4 F

267 20:15:03
002 22.4 F 003 22.4 F

267 20:17:03
002 22.4 F 003 22.4 F

267 20:19:03
002 22.5 F 003 22.4 F

267 20:21:03
002 22.5 F 003 22.3 F

267 20:23:03
002 22.5 F 003 22.4 F

267 20:25:03
002 22.3 F 003 22.3 F

267 20:27:03

002 22.4 F 003 22.4 F

267 20:29:03
002 22.5 F 003 22.4 F

267 20:31:03
002 22.3 F 003 22.3 F

267 20:33:03
002 22.4 F 003 22.4 F

267 20:35:03
002 22.4 F 003 22.6 F

267 20:37:03
002 22.4 F 003 22.3 F

267 20:39:03
002 22.4 F 003 22.3 F

267 20:41:03
002 22.3 F 003 22.3 F

267 20:43:03
002 22.4 F 003 22.3 F

267 20:45:03
002 22.6 F 003 22.4 F

267 20:47:03
002 22.5 F 003 22.4 F

267 20:49:03
002 22.4 F 003 22.4 F

267 20:51:03
002 22.5 F 003 22.4 F

267 20:53:03
002 22.5 F 003 22.3 F

267 20:55:03
002 22.3 F 003 22.4 F

267 20:57:03
002 22.6 F 003 22.4 F

267 20:59:03
002 22.3 F 003 22.3 F

267 21:01:03
002 22.4 F 003 22.4 F

267 21:03:03
002 22.4 F 003 22.3 F

267 21:05:03

002 22.5 F 003 22.3 F

267 21:07:03
002 22.5 F 003 22.4 F

267 21:09:03
002 22.3 F 003 22.3 F

267 21:11:03
002 22.5 F 003 22.4 F

267 21:13:03
002 22.5 F 003 22.4 F

267 21:15:03
002 22.2 F 003 22.3 F

267 21:17:03
002 22.3 F 003 22.4 F

267 21:19:03
002 22.5 F 003 22.4 F

267 21:21:03
002 22.4 F 003 22.4 F

267 21:23:03
002 22.5 F 003 22.4 F

267 21:25:03
002 22.6 F 003 22.4 F

267 21:27:03
002 22.4 F 003 22.4 F

267 21:29:03
002 22.4 F 003 22.4 F

267 21:31:03
002 22.4 F 003 22.3 F

267 21:33:03
002 22.4 F 003 22.4 F

267 21:35:03
002 22.5 F 003 22.4 F

267 21:37:03
002 22.3 F 003 22.3 F

267 21:39:03
002 22.2 F 003 22.2 F

267 21:41:03
002 22.3 F 003 22.3 F

267 21:43:03

002 22.3 F 003 22.3 F

267 21:45:03
002 22.3 F 003 22.3 F

267 21:47:03
002 22.5 F 003 22.4 F

267 21:49:03
002 22.4 F 003 22.3 F

267 21:51:03
002 22.3 F 003 22.3 F

267 21:53:03
002 22.4 F 003 22.3 F

267 21:55:03
002 22.3 F 003 22.4 F

267 21:57:03
002 22.5 F 003 22.4 F

267 21:59:03
002 22.3 F 003 22.3 F

267 22:01:03
002 22.4 F 003 22.3 F

267 22:03:03
002 22.4 F 003 22.3 F

267 22:05:03
002 22.3 F 003 22.3 F

267 22:07:03
002 22.4 F 003 22.4 F

267 22:09:03
002 22.4 F 003 22.3 F

267 22:11:03
002 22.2 F 003 22.3 F

267 22:13:03
002 22.4 F 003 22.3 F

267 22:15:03
002 22.3 F 003 22.2 F

267 22:17:03
002 22.4 F 003 22.3 F

267 22:19:03
002 22.4 F 003 22.3 F

267 22:21:03

002 22.4 F 003 22.3 F

267 22:23:03
002 22.4 F 003 22.3 F

267 22:25:03
002 22.5 F 003 22.3 F

267 22:27:03
002 22.6 F 003 22.3 F

267 22:29:03
002 22.4 F 003 22.4 F

267 22:31:03
002 22.5 F 003 22.3 F

267 22:33:03
002 22.5 F 003 22.4 F

267 22:35:03
002 22.4 F 003 22.3 F

267 22:37:03
002 22.3 F 003 22.3 F

267 22:39:03
002 22.3 F 003 22.3 F

267 22:41:03
002 22.3 F 003 22.3 F

267 22:43:03
002 22.3 F 003 22.3 F

267 22:45:03
002 22.3 F 003 22.3 F

267 22:47:03
002 22.3 F 003 22.3 F

267 22:49:03
002 22.3 F 003 22.2 F

267 22:51:03
002 22.4 F 003 22.3 F

267 22:53:03
002 22.2 F 003 22.2 F

267 22:55:03
002 22.3 F 003 22.2 F

267 22:57:03
002 22.6 F 003 22.4 F

267 22:59:03

002 22.4 F 003 22.3 F

267 23:01:03
002 22.2 F 003 22.3 F

267 23:03:03
002 22.4 F 003 22.3 F

267 23:05:03
002 22.4 F 003 22.3 F

267 23:07:03
002 22.6 F 003 22.3 F

267 23:09:03
002 22.4 F 003 22.4 F

267 23:11:03
002 22.3 F 003 22.3 F

267 23:13:03
002 22.3 F 003 22.2 F

267 23:15:03
002 22.3 F 003 22.3 F

267 23:17:03
002 22.5 F 003 22.3 F

267 23:19:03
002 22.3 F 003 22.3 F

267 23:21:03
002 22.3 F 003 22.2 F

267 23:23:03
002 22.2 F 003 22.3 F

267 23:25:03
002 22.2 F 003 22.3 F

267 23:27:03
002 22.4 F 003 22.2 F

267 23:29:03
002 22.3 F 003 22.3 F

267 23:31:03
002 22.5 F 003 22.3 F

267 23:33:03
002 22.3 F 003 22.2 F

267 23:35:03
002 22.5 F 003 22.3 F

267 23:37:03

002 22.2 F 003 22.2 F
267 23:39:03
002 22.3 F 003 22.2 F
267 23:41:03
002 22.3 F 003 22.3 F
267 23:43:03
002 22.2 F 003 22.3 F
267 23:45:03
002 22.4 F 003 22.4 F
267 23:47:03
002 22.3 F 003 22.3 F
267 23:49:03
002 22.3 F 003 22.2 F
267 23:51:03
002 22.3 F 003 22.2 F
267 23:53:03
002 22.5 F 003 22.3 F
267 23:55:03
002 22.2 F 003 22.3 F
267 23:57:03
002 22.4 F 003 22.3 F
267 23:59:03
002 22.2 F 003 22.2 F
268 00:01:03
002 22.5 F 003 22.3 F
268 00:03:03
002 22.6 F 003 22.4 F
268 00:05:03
002 22.3 F 003 22.3 F
268 00:07:03
002 22.3 F 003 22.2 F
268 00:09:03
002 22.3 F 003 22.2 F
268 00:11:03
002 22.3 F 003 22.2 F
268 00:13:03
02 22.4 F 003 22.3 F
268 00:15:03

002 22.4 F 003 22.3 F
268 00:17:03
002 22.4 F 003 22.2 F
268 00:19:03
002 22.3 F 003 22.2 F
268 00:21:03
002 22.2 F 003 22.2 F
268 00:23:03
002 22.3 F 003 22.2 F
268 00:25:03
002 22.4 F 003 22.3 F
268 00:27:03
002 22.3 F 003 22.2 F
268 00:29:03
002 22.4 F 003 22.3 F
268 00:31:03
002 22.3 F 003 22.3 F
268 00:33:03
002 22.3 F 003 22.2 F
268 00:35:03
002 22.4 F 003 22.3 F
268 00:37:03
002 22.4 F 003 22.3 F
268 00:39:03
002 22.4 F 003 22.3 F
268 00:41:03
002 22.4 F 003 22.3 F
268 00:43:03
002 22.2 F 003 22.2 F
268 00:45:03
002 22.3 F 003 22.2 F
268 00:47:03
002 22.4 F 003 22.3 F
268 00:49:03
002 22.4 F 003 22.3 F
268 00:51:03
002 22.4 F 003 22.3 F
268 00:53:03

002 22.3 F 003 22.2 F

268 00:55:03
002 22.3 F 003 22.2 F

268 00:57:03
002 22.3 F 003 22.2 F

268 00:59:03
002 22.4 F 003 22.4 F

268 01:01:03
002 22.2 F 003 22.2 F

268 01:03:03
002 22.3 F 003 22.2 F

268 01:05:03
002 22.2 F 003 22.2 F

268 01:07:03
002 22.2 F 003 22.2 F

268 01:09:03
002 22.4 F 003 22.2 F

268 01:11:03
002 22.2 F 003 22.2 F

268 01:13:03
002 22.1 F 003 22.2 F

268 01:15:03
002 22.2 F 003 22.2 F

268 01:17:03
002 22.3 F 003 22.2 F

268 01:19:03
002 22.2 F 003 22.2 F

268 01:21:03
002 22.3 F 003 22.3 F

268 01:23:03
002 22.4 F 003 22.3 F

268 01:25:03
002 22.2 F 003 22.3 F

268 01:27:03
002 22.2 F 003 22.2 F

268 01:29:03
002 22.5 F 003 22.3 F

268 01:31:03

002 22.4 F 003 22.3 F

268 01:33:03
002 22.3 F 003 22.3 F

268 01:35:03
002 22.5 F 003 22.3 F

268 01:37:03
002 22.3 F 003 22.3 F

268 01:39:03
002 22.3 F 003 22.2 F

268 01:41:03
002 22.3 F 003 22.2 F

268 01:43:03
002 22.5 F 003 22.3 F

268 01:45:03
002 22.3 F 003 22.2 F

268 01:47:03
002 22.4 F 003 22.3 F

268 01:49:03
002 22.5 F 003 22.3 F

268 01:51:03
002 22.3 F 003 22.3 F

268 01:53:03
002 22.3 F 003 22.3 F

268 01:55:03
002 22.4 F 003 22.3 F

268 01:57:03
002 22.4 F 003 22.3 F

268 01:59:03
002 22.2 F 003 22.3 F

268 02:01:03
002 22.3 F 003 22.2 F

268 02:03:03
002 22.4 F 003 22.2 F

268 02:05:03
002 22.2 F 003 22.3 F

268 02:07:03
002 22.3 F 003 22.3 F

268 02:09:03

002 22.4 F 003 22.3 F

268 02:11:03
002 22.3 F 003 22.2 F

268 02:13:03
002 22.4 F 003 22.2 F

268 02:15:03
002 22.4 F 003 22.3 F

268 02:17:03
002 22.1 F 003 22.2 F

268 02:19:03
002 22.6 F 003 22.3 F

268 02:21:03
002 22.4 F 003 22.2 F

268 02:23:03
002 22.3 F 003 22.2 F

268 02:25:03
002 22.2 F 003 22.2 F

268 02:27:03
002 22.4 F 003 22.2 F

268 02:29:03
002 22.3 F 003 22.2 F

268 02:31:03
002 22.5 F 003 22.4 F

268 02:33:03
002 22.4 F 003 22.2 F

268 02:35:03
002 22.4 F 003 22.3 F

268 02:37:03
002 22.4 F 003 22.3 F

268 02:39:03
002 22.4 F 003 22.2 F

268 02:41:03
002 22.4 F 003 22.3 F

268 02:43:03
002 22.5 F 003 22.3 F

268 02:45:03
002 22.4 F 003 22.2 F

268 02:47:03

002 22.4 F 003 22.3 F

268 02:49:03
002 22.3 F 003 22.3 F

268 02:51:03
002 22.4 F 003 22.2 F

268 02:53:03
002 22.5 F 003 22.4 F

268 02:55:03
002 22.4 F 003 22.3 F

268 02:57:03
002 22.5 F 003 22.2 F

268 02:59:03
002 22.4 F 003 22.3 F

268 03:01:03
002 22.6 F 003 22.3 F

268 03:03:03
002 22.4 F 003 22.3 F

268 03:05:03
002 22.4 F 003 22.4 F

268 03:07:03
002 22.5 F 003 22.3 F

268 03:09:03
002 22.6 F 003 22.3 F

268 03:11:03
002 22.3 F 003 22.3 F

268 03:13:03
002 22.3 F 003 22.2 F

268 03:15:03
002 22.3 F 003 22.3 F

268 03:17:03
002 22.3 F 003 22.2 F

268 03:19:03
002 22.4 F 003 22.3 F

268 03:21:03
002 22.4 F 003 22.3 F

268 03:23:03
002 22.4 F 003 22.2 F

268 03:25:03

002 22.5 F 003 22.3 F

268 03:27:03
002 22.4 F 003 22.3 F

268 03:29:03
002 22.4 F 003 22.3 F

268 03:31:03
002 22.5 F 003 22.4 F

268 03:33:03
002 22.6 F 003 22.4 F

268 03:35:03
002 22.4 F 003 22.3 F

268 03:37:03
002 22.7 F 003 22.4 F

268 03:39:03
002 22.5 F 003 22.3 F

268 03:41:03
002 22.5 F 003 22.4 F

268 03:43:03
002 22.5 F 003 22.3 F

268 03:45:03
002 22.2 F 003 22.1 F

268 03:47:03
002 22.4 F 003 22.2 F

268 03:49:03
002 22.4 F 003 22.3 F

268 03:51:03
002 22.4 F 003 22.2 F

268 03:53:03
002 22.4 F 003 22.3 F

268 03:55:03
002 22.5 F 003 22.5 F

268 03:57:03
002 22.4 F 003 22.4 F

268 03:59:03
002 22.4 F 003 22.5 F

268 04:01:03
002 22.3 F 003 22.3 F

268 04:03:03

002 22.7 F 003 22.4 F

268 04:05:03
002 22.5 F 003 22.4 F

268 04:07:03
002 22.6 F 003 22.4 F

268 04:09:03
002 22.5 F 003 22.4 F

268 04:11:03
002 22.7 F 003 22.5 F

268 04:13:03
002 22.4 F 003 22.3 F

268 04:15:03
002 22.4 F 003 22.3 F

268 04:17:03
002 22.4 F 003 22.3 F

268 04:19:03
002 22.4 F 003 22.3 F

268 04:21:03
002 22.4 F 003 22.3 F

268 04:23:03
002 22.5 F 003 22.3 F

268 04:25:03
002 22.4 F 003 22.3 F

268 04:27:03
002 22.5 F 003 22.4 F

268 04:29:03
002 22.4 F 003 22.3 F

268 04:31:03
002 22.4 F 003 22.3 F

268 04:33:03
002 22.6 F 003 22.4 F

268 04:35:03
002 22.5 F 003 22.3 F

268 04:37:03
002 22.8 F 003 22.4 F

268 04:39:03
002 22.5 F 003 22.4 F

268 04:41:03

002 22.5 F 003 22.3 F

268 04:43:03
002 22.5 F 003 22.3 F

268 04:45:03
002 22.5 F 003 22.1 F

268 04:47:03
002 22.5 F 003 22.4 F

268 04:49:03
002 22.5 F 003 22.4 F

268 04:51:03
002 22.3 F 003 22.5 F

268 04:53:03
002 22.4 F 003 22.3 F

268 04:55:03
002 22.3 F 003 22.3 F

268 04:57:03
002 22.4 F 003 22.4 F

268 04:59:03
002 22.5 F 003 22.4 F

268 05:01:03
002 22.5 F 003 22.4 F

268 05:03:03
002 22.4 F 003 22.3 F

268 05:05:03
002 22.5 F 003 22.3 F

268 05:07:03
002 22.3 F 003 22.3 F

268 05:09:03
002 22.5 F 003 22.4 F

268 05:11:03
002 22.6 F 003 22.5 F

268 05:13:03
002 22.4 F 003 22.3 F

268 05:15:03
002 22.5 F 003 22.3 F

268 05:17:03
002 22.6 F 003 22.4 F

268 05:19:03

002 22.4 F 003 22.3 F

268 05:21:03
002 22.3 F 003 22.3 F

268 05:23:03
002 22.5 F 003 22.4 F

268 05:25:03
002 22.5 F 003 22.3 F

268 05:27:03
002 22.4 F 003 22.3 F

268 05:29:03
002 22.5 F 003 22.3 F

268 05:31:03
002 22.5 F 003 22.3 F

268 05:33:03
002 22.6 F 003 22.4 F

268 05:35:03
002 22.4 F 003 22.4 F

268 05:37:03
002 22.4 F 003 22.3 F

268 05:39:03
002 22.5 F 003 22.4 F

268 05:41:03
002 22.5 F 003 22.3 F

268 05:43:03
002 22.5 F 003 22.3 F

268 05:45:03
002 22.4 F 003 22.4 F

268 05:47:03
002 22.4 F 003 22.3 F

268 05:49:03
002 22.5 F 003 22.3 F

268 05:51:03
002 22.5 F 003 22.3 F

268 05:53:03
002 22.5 F 003 22.3 F

268 05:55:03
002 22.7 F 003 22.4 F

268 05:57:03

002 22.4 F 003 22.4 F

268 05:59:03
002 22.5 F 003 22.3 F

268 06:01:03
002 22.4 F 003 22.3 F

268 06:03:03
002 22.3 F 003 22.3 F

268 06:05:03
002 22.5 F 003 22.3 F

268 06:07:03
002 22.5 F 003 22.4 F

268 06:09:03
002 22.4 F 003 22.3 F

268 06:11:03
002 22.4 F 003 22.4 F

268 06:13:03
002 22.4 F 003 22.3 F

268 06:15:03
002 22.5 F 003 22.3 F

268 06:17:03
002 22.5 F 003 22.3 F

268 06:19:03
002 22.6 F 003 22.3 F

268 06:21:03
002 22.3 F 003 22.4 F

268 06:23:03
002 22.5 F 003 22.3 F

268 06:25:03
002 22.5 F 003 22.3 F

268 06:27:03
002 22.3 F 003 22.3 F

268 06:29:03
002 22.4 F 003 22.3 F

268 06:31:03
002 22.3 F 003 22.2 F

268 06:33:03
002 22.5 F 003 22.3 F

268 06:35:03

002 22.3 F 003 22.3 F

268 06:37:03
002 22.4 F 003 22.2 F

268 06:39:03
002 22.4 F 003 22.3 F

268 06:41:03
002 22.3 F 003 22.2 F

268 06:43:03
002 22.4 F 003 22.3 F

268 06:45:03
002 22.5 F 003 22.4 F

268 06:47:03
002 22.6 F 003 22.3 F

268 06:49:03
002 22.8 F 003 22.7 F

268 06:51:03
002 22.5 F 003 22.4 F

268 06:53:03
002 22.4 F 003 22.3 F

268 06:55:03
002 22.5 F 003 22.3 F

268 06:57:03
002 22.4 F 003 22.3 F

268 06:59:03
002 22.5 F 003 22.3 F

268 07:01:03
002 22.4 F 003 22.2 F

268 07:03:03
002 22.5 F 003 22.2 F

268 07:05:03
002 22.2 F 003 22.2 F

268 07:07:03
002 22.4 F 003 22.2 F

268 07:09:03
002 22.5 F 003 22.2 F

268 07:11:03
002 22.4 F 003 22.2 F

268 07:13:03

002 22.2 F 003 22.2 F

268 07:15:03
002 22.3 F 003 22.2 F

268 07:17:03
002 22.5 F 003 22.2 F

268 07:19:03
002 22.3 F 003 22.2 F

268 07:21:03
002 22.3 F 003 22.2 F

268 07:23:03
002 22.3 F 003 22.2 F

268 07:25:03
002 22.3 F 003 22.2 F

268 07:27:03
002 22.4 F 003 22.2 F

268 07:29:03
002 22.3 F 003 22.2 F

268 07:31:03
002 22.5 F 003 22.3 F

268 07:33:03
002 22.5 F 003 22.3 F

268 07:35:03
002 22.4 F 003 22.3 F

268 07:37:03
002 22.2 F 003 22.2 F

268 07:39:03
002 22.6 F 003 22.3 F

268 07:41:03
002 22.5 F 003 22.2 F

268 07:43:03
002 22.3 F 003 22.3 F

268 07:45:03
002 22.5 F 003 22.3 F

268 07:47:03
002 22.3 F 003 22.2 F

268 07:49:03
002 22.4 F 003 22.2 F

268 07:51:03

002 22.3 F 003 22.3 F

268 07:53:03
002 22.5 F 003 22.3 F

268 07:55:03
002 22.5 F 003 22.3 F

268 07:57:03
002 22.3 F 003 22.3 F

268 07:59:03
002 22.3 F 003 22.3 F

268 08:01:03
002 22.5 F 003 22.3 F

268 08:03:03
002 22.4 F 003 22.2 F

268 08:05:03
002 22.4 F 003 22.4 F

268 08:07:03
002 22.4 F 003 22.3 F

268 08:09:03
002 22.2 F 003 22.3 F

268 08:11:03
002 22.5 F 003 22.3 F

268 08:13:03
002 22.3 F 003 22.3 F

268 08:15:03
002 22.3 F 003 22.3 F

268 08:17:03
002 22.6 F 003 22.4 F

268 08:19:03
002 22.6 F 003 22.4 F

268 08:21:03
002 22.5 F 003 22.3 F

268 08:23:03
002 22.5 F 003 22.3 F

268 08:25:03
002 22.4 F 003 22.3 F

268 08:27:03
002 22.6 F 003 22.4 F

268 08:29:03

002 22.5 F 003 22.4 F

268 08:31:03
002 22.5 F 003 22.4 F

268 08:33:03
002 22.4 F 003 22.3 F

268 08:35:03
002 22.6 F 003 22.4 F

268 08:37:03
002 22.5 F 003 22.4 F

268 08:39:03
002 22.5 F 003 22.4 F

268 08:41:03
002 22.6 F 003 22.5 F

268 08:43:03
002 22.5 F 003 22.4 F

268 08:45:03
002 22.5 F 003 22.4 F

268 08:47:03
002 22.4 F 003 22.4 F

268 08:49:03
002 22.5 F 003 22.4 F

268 08:51:03
002 22.4 F 003 22.4 F

268 08:53:03
002 22.5 F 003 22.3 F

268 08:55:03
002 22.5 F 003 22.4 F

268 08:57:03
002 22.4 F 003 22.4 F

268 08:59:03
002 22.4 F 003 22.3 F

268 09:01:03
002 22.4 F 003 22.3 F

268 09:03:03
002 22.5 F 003 22.4 F

268 09:05:03
002 22.6 F 003 22.4 F

268 09:07:03

002 22.5 F 003 22.3 F

268 09:09:03
002 22.5 F 003 22.2 F

268 09:11:03
002 22.4 F 003 22.4 F

268 09:13:03
002 22.5 F 003 22.4 F

268 09:15:03
002 22.4 F 003 22.3 F

268 09:17:03
002 22.6 F 003 22.3 F

268 09:19:03
002 22.4 F 003 22.3 F

268 09:21:03
002 22.3 F 003 22.3 F

268 09:23:03
002 22.5 F 003 22.3 F

268 09:25:03
002 22.5 F 003 22.3 F

268 09:27:03
002 22.6 F 003 22.4 F

268 09:29:03
002 22.7 F 003 22.4 F

268 09:31:03
002 22.5 F 003 22.4 F

268 09:33:03
002 22.5 F 003 22.4 F

268 09:35:03
002 22.5 F 003 22.5 F

268 09:37:03
002 22.5 F 003 22.3 F

268 09:39:03
002 22.5 F 003 22.3 F

268 09:41:03
002 22.5 F 003 22.3 F

268 09:43:03
002 22.5 F 003 22.4 F

268 09:45:03

002 22.4 F 003 22.3 F

268 09:47:03
002 22.4 F 003 22.3 F

268 09:49:03
002 22.4 F 003 22.2 F

268 09:51:03
002 22.5 F 003 22.3 F

268 09:53:03
002 22.6 F 003 22.4 F

268 09:55:03
002 22.4 F 003 22.3 F

268 09:57:03
002 22.5 F 003 22.2 F

268 09:59:03
002 22.3 F 003 22.3 F

268 10:01:03
002 22.7 F 003 22.5 F

268 10:03:03
002 22.5 F 003 22.2 F

268 10:05:03
002 22.4 F 003 22.3 F

268 10:07:03
002 22.7 F 003 22.3 F

268 10:09:03
002 22.4 F 003 22.4 F

268 10:11:03
002 22.4 F 003 22.3 F

268 10:13:03
002 22.4 F 003 22.3 F

268 10:15:03
002 22.5 F 003 22.3 F

268 10:17:03
002 22.4 F 003 22.3 F

268 10:19:03
002 22.4 F 003 22.3 F

268 10:21:03
002 22.4 F 003 22.3 F

268 10:23:03

002 22.6 F 003 22.4 F

268 10:25:03
002 22.5 F 003 22.3 F

268 10:27:03
002 22.4 F 003 22.3 F

268 10:29:03
002 22.5 F 003 22.4 F

268 10:31:03
002 22.7 F 003 22.4 F

268 10:33:03
002 22.6 F 003 22.4 F

268 10:35:03
002 22.5 F 003 22.4 F

268 10:37:03
002 22.5 F 003 22.3 F

268 10:39:03
002 22.5 F 003 22.4 F

268 10:41:03
002 22.4 F 003 22.3 F

268 10:43:03
002 22.5 F 003 22.3 F

268 10:45:03
002 22.5 F 003 22.3 F

268 10:47:03
002 22.5 F 003 22.3 F

268 10:49:03
002 22.5 F 003 22.3 F

268 10:51:03
002 22.5 F 003 22.4 F

268 10:53:03
002 22.6 F 003 22.4 F

268 10:55:03
002 22.5 F 003 22.5 F

268 10:57:03
002 22.5 F 003 22.4 F

268 10:59:03
002 22.5 F 003 22.3 F

268 11:01:03

002 22.6 F 003 22.5 F

268 11:03:03
002 22.7 F 003 22.4 F

268 11:05:03
002 22.6 F 003 22.4 F

268 11:07:03
002 22.5 F 003 22.4 F

268 11:09:03
002 22.6 F 003 22.5 F

268 11:11:03
002 22.5 F 003 22.4 F

268 11:13:03
002 22.5 F 003 22.4 F

268 11:15:03
002 22.8 F 003 22.4 F

268 11:17:03
002 22.7 F 003 22.5 F

268 11:19:03
002 22.8 F 003 22.7 F

268 11:21:03
002 22.5 F 003 22.6 F

268 11:23:03
002 22.8 F 003 22.6 F

268 11:25:03
002 22.7 F 003 22.6 F

268 11:27:03
002 22.6 F 003 22.6 F

268 11:29:03
002 22.9 F 003 22.8 F

268 11:31:03
002 23.1 F 003 23.0 F

268 11:33:03
002 23.0 F 003 23.0 F

268 11:35:03
002 23.1 F 003 23.0 F

268 11:37:03
002 25.3 F 003 24.4 F

268 11:39:03

002 26.7 F 003 25.9 F

268 11:41:03
002 26.8 F 003 26.3 F

268 11:43:03
002 25.2 F 003 24.8 F

268 11:45:03
002 25.7 F 003 25.4 F

268 11:47:03
002 25.4 F 003 25.1 F

268 11:49:03
002 24.8 F 003 24.5 F

268 11:51:03
002 24.5 F 003 24.4 F

268 11:53:03
002 24.5 F 003 24.3 F

268 11:55:03
002 24.3 F 003 24.1 F

268 11:57:03
002 24.4 F 003 24.1 F

268 11:59:03
002 27.8 F 003 27.7 F

268 12:01:03
002 24.7 F 003 24.6 F

268 12:03:03
002 24.6 F 003 24.5 F

268 12:05:03
002 24.7 F 003 24.4 F

268 12:07:03
002-****.* F 003-****.* F

268 12:09:03
002-****.* F 003-****.* F

268 12:11:03
002-****.* F 003-****.* F

268 12:13:03
002-****.* F 003-****.* F

268 12:15:03
002-****.* F 003-****.* F

268 12:17:03

002-****.* F 003-****.* F

268 12:19:03
002-****.* F 003-****.* F

268 12:21:03
002-****.* F 003-****.* F

268 12:23:03
002-****.* F 003 44.8 F

268 12:25:03
002 32.2 F 003 30.6 F

268 12:27:03
002 27.2 F 003 26.5 F

268 12:29:03
002 24.9 F 003 24.5 F

268 12:31:03
002 23.7 F 003 23.2 F

268 12:33:03
002 24.3 F 003 23.8 F

268 12:35:03
002 24.3 F 003 23.7 F

268 12:37:03
002 23.8 F 003 23.3 F

268 12:39:03
002 23.0 F 003 22.7 F

268 12:41:03
002 22.7 F 003 22.2 F

268 12:43:03
002 22.5 F 003 22.0 F

268 12:45:03
002 22.2 F 003 19.8 F

268 12:47:03
002 22.2 F 003 21.8 F

268 12:49:03
002 22.3 F 003 21.9 F

268 12:51:03
002 22.2 F 003 21.9 F

268 12:53:03
002 22.4 F 003 22.0 F

268 12:55:03

002 22.0 F 003 21.9 F

268 12:57:03
002 22.0 F 003 21.9 F

268 12:59:03
002 22.1 F 003 21.7 F

268 13:01:03
002 21.8 F 003 21.4 F

268 13:03:03
002 21.7 F 003 21.6 F

268 13:05:03
002 21.8 F 003 21.4 F

268 13:07:03
002 21.6 F 003 21.3 F

268 13:09:03
002 21.6 F 003 21.5 F

268 13:11:03
002 21.7 F 003 21.5 F

268 13:13:03
002 21.8 F 003 21.4 F

268 13:15:03
002 21.8 F 003 21.5 F

268 13:17:03
002 22.0 F 003 21.8 F

268 13:19:03
002 22.3 F 003 22.6 F

268 13:21:03
002 22.6 F 003 22.6 F

268 13:23:03
002 22.6 F 003 22.4 F

268 13:25:03
002 22.5 F 003 22.3 F

268 13:27:03
002 22.6 F 003 22.5 F

268 13:29:03
002 22.4 F 003 22.6 F

268 13:31:03
002-****.* F 003-****.* F

268 13:33:03

002-****.* F 003-****.* F

268 13:35:03
002-****.* F 003-****.* F

268 13:37:03
002-****.* F 003-****.* F

268 13:39:03
002-****.* F 003-****.* F

268 13:41:03
002-****.* F 003-****.* F

268 13:43:03
002 31.7 F 003 34.6 F

268 13:45:03
002 28.0 F 003 31.0 F

268 13:47:03
002 26.1 F 003 29.3 F

268 13:49:03
002 24.9 F 003 27.6 F

268 13:51:03
002 24.3 F 003 26.8 F

268 13:53:03
002 23.7 F 003 26.0 F

268 13:55:03
002 22.9 F 003 25.2 F

268 13:57:03
002 22.6 F 003 24.8 F

268 13:59:03
002 22.0 F 003 24.1 F

268 14:01:03
002 21.9 F 003 23.8 F

268 14:03:03
002 21.8 F 003 23.4 F

268 14:05:03
002 21.6 F 003 23.1 F

268 14:07:03
002 21.2 F 003 23.1 F

268 14:09:03
002 21.1 F 003 22.9 F

268 14:11:03

002 21.0 F 003 22.8 F

268 14:13:03
002 21.3 F 003 22.7 F

268 14:15:03
002 20.8 F 003 22.5 F

268 14:17:03
002 20.9 F 003 22.5 F

268 14:19:03
002 20.8 F 003 22.3 F

268 14:21:03
002 21.1 F 003 22.7 F

268 14:23:03
002 21.1 F 003 22.5 F

268 14:25:03
002 21.3 F 003 22.7 F

268 14:27:03
002 21.4 F 003 22.8 F

268 14:29:03
002 21.7 F 003 22.9 F

268 14:31:03
002 21.5 F 003 23.0 F

268 14:33:03
002 21.5 F 003 22.8 F

268 14:35:03
002 21.5 F 003 22.8 F

268 14:37:03
002-****.* F 003-****.* F

268 14:39:03
002-****.* F 003-****.* F

268 14:41:03
002-****.* F 003-****.* F

268 14:43:03
002-****.* F 003-****.* F

National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

BSM-TCP-EP54-004

BSM Delta Qualification Test

Procedure for the Move of the Shipping Container from the Vibration Test Area to the Pyro Shock Test Area

This Procedure Describes **Safety Critical** Operations

MSFC - Cover 2 (Rev. June 1980)

BSM Delta Qualification Test

Procedure for the Move of the Shipping Container from the Vibration Test Area to the Pyro Shock Test Area

Prepared by:

Mat Bevill EP-12

08/16/93

Motor SN: 1060734

Test Date: 09/27/93

Move Shipping Container to Pyro Shock Area for Delivery

Prepared by:

Mat Bevill/MSFC TE/EP12 — 09/15/93
Date

Approved by:

Jim McGee/MSFC Vibration Lab TE — 9-14-93
Date

Jim Herring/MSFC Pyro Shock Lab TE — 9-14-93
Date

Richard Leonard/MSFC Safety/CS01 — 9-16-93
Date

Rick Clements/MSFC Quality/CQ06 — 9-15-93
Date

Ben Goldberg/Motor Systems Division/EP11 — 9/14/93
Date

Steve Brewster/Dynamic Test Branch/ED73 — 9/14/93
Date

Chuck Wells/UTC/CSD TE — 9/16/93
Date

Don Wencil/USBI — 9-14-93
Date

Charlie Lovell/PCH Engineer/CN71 — 9/16/93
Date

Move Shipping Container to Pyro Shock Area for Delivery

Prepared by:	Mat Bevill/MSFC TE/EP12	09/15/93 Date
Approved by:	Jim McGee/MSFC Vibration Lab TE	9-14-93 Date
	Jim Herring/MSFC Pyro Shock Lab TE	9-14-93 Date
	Richard Leonard/MSFC Safety/CS01	9-16-93 Date
	Rick Clements/MSFC Quality/CQ06	9-15-93 Date
	Ben Goldberg/Motor Systems Division/EP11	9/14/93 Date
	Steve Brewster/Dynamic Test Branch/ED73	9/14/93 Date
	Chuck Wells/UTC/CSD TE	Date
	Don Wencil/USBI	9-14-93 Date
	Charlie Lovell/PCH Engineer/CN71	9/16/93 Date

Table of Contents

1.0 General Information

1.1 Scope

This test procedure addresses all the requirements to move the BSM shipping container from the vibration test area to the pyro shock test area. The shipping container will remain in the pyro shock area until delivery to the NASA igloo.

1.2 Objective of Qualification Tests

The objective of the dynamic testing is to verify the physical and functional survivability of the Booster Separation Motors. Of particular interest for these tests are the components bonded using EA9394 adhesive. The components using this adhesive include the throat insert, the centering insert, and the igniter grain support rod.

2.0 Applicable Documents

MSFC-STD-513A	Certification of Equipment Operations and Materials Handling Personnel
EG5300.36A	Safety
29 CFR 1910	Occupational Safety and Health Administration (OSHA)
NSS/GO 1740.9	Safety Standard for Lifting Devices and Equipment
NHB 1700.1(V1)	Basic Safety Manual
AMC-R 385-100	Safety Manual
EP01-SOP-01	Standard Operating Procedure for Safety Critical Operations
MM 1700.4	Safety and Environmental Health Hazards
MMI 1700.17	MSFC Procedures for Acquiring Shipping Permits for Rocket Motors and Igniters
MMI 1710.1	Safety Review and Approval of Hazardous and Potentially Hazardous Facilities and Activities at MSFC
MMI 1710.6	MSFC Program for Personnel Certification
MMI 1711.2	Mishap Reporting and Investigation

MMI 1845.1	Hazard Communication Program
MMI 6400.2	Packaging, Handling, and Moving Program Critical Hardware
MSFC-RQMT-1493	Electrostatic Discharge Control Requirements
MSFC-STD-1800	Electrostatic Discharge (ESD) Control for Propellant and Explosive Devices
MSFC-STD-126E	Inspection, Maintenance, Proof Testing and Certification of Handling Equipment
CSD-5597-93-1 Rev. B	Enhanced Delta Qualification Test Plan for Booster Separation Motor (BSM), Aug. 6, 1993
10SPC-0067 Rev. A	Specification for Booster Separation Motors for Space Shuttle Solid Rocket Booster (thru SCN 014)

3.0 **Safety**

3.1 The following safety criteria are in accordance with ET01-SOP-01, Rev. A., *Standard Operation Procedures for Safety Critical Operations"*. If safety rules/regulations are not followed, injury to personnel and/or damage to test items could occur.

Emergency telephone numbers are as follows:

Safety	4-0046
Ambulance	112
Fire	117
Security	4-4357
Utilities	4-3919
Medical Center	4-2390
Communication Repair	4-1771

3.2 Prior to starting work in 4619 a visual inspection of work area shall be made for anomalies by task supervisor and safety personnel.

MSFC TE MB MSFC SE RyS

Date / Time: 09/27/93 4:30 p.m.

3.3 Personnel shall not work or position themselves beneath suspended loads unless such loads are securely and adequately blocked up.

9-27-93

3.4 Objects handled by overhead hoist shall be lifted only high enough to clear fixed objects in the path of travel. Spreader bars and slings may be left on the hoist if desired when not in use, but must be raised so that the lowest part of the lifting equipment will be at least seven feet from the floor when not in use.

3.5 Crane, hoist, lift prime operators, and riggers shall be certified according to the latest revision of MMI 1710.6, and shall have in their possession a valid certification card.

Certifications checked by: MB

Date / Time: 09/27/93

3.6 Personnel working around suspended loads shall be alert to the possibility of being crushed between the suspended load and a fixed object.

3.7 Loads shall be moved slowly so they will not accumulate more momentum than can be stopped with little or no swing.

3.8 Where handling slings are called out, a sling with more pickup points than required may be used if the weight capacity per point used is equal or greater than the weight capacity of each point of the noted sling and the free pickup point is (are) secured to prevent it (them) from swinging and causing damage to parts.

3.9 Only the area coordinator should direct the crane moves, however, any person determining an immediate danger or problem may request stoppage of activities.

3.10 The lifting or transportation operation shall be halted by the area coordinator at any time the control area cannot be maintained.

3.11 Steel toe shoes are required during lifting operations. Hardhats are required when the lift is at or above the shoulders.

3.12 Tag line operators are to wear leather gloves.

3.13 The primary safety hazards associated with this operation are:

3.13.1 Lift operations
3.13.4 Live (Loaded) Solid Rocket Motor

9-27-93

3.14 Any time a crane is being used, it must be dogged if:

3.14.1 The load will be suspended in a static condition for an extended amount of time.

3.14.2 A crane operator crew change or substitution must be made.

3.15 Inspection certifications shall be provided for the forklift used to lift the motor shipping container.

Forklift certification provided MB MSFC TE

3.16 No electric power tools shall be used near the live test item. Use of pneumatic tools is acceptable.

3.17 All ground cables and ground straps end-to-end resistances shall be verified with a multimeter. These resistances must measure less than 1 ohm.

3.18 All personnel within touching distance shall wear a wrist strap that has been checked with a wrist strap checker. This step should be performed each time the wrist strap ground is broken.

3.19 All personnel within touching distance of open grain propellant (and ordnance) shall wear antistatic coveralls.

4.0 Test Items, Test Equipment, and Move Procedure

4.1 Test Items

For this procedure, the test item should already be placed in its shipping container and secured to its shipping pallet.

Motor Serial Number for this move: 1000734

4.2 Test Equipment

4.2.1 Proof Loading of Handling Equipment (required for PCH)

4.2.1.1 The heaviest lift during all of the delta qualification testing will be lifting the motor while in its shipping container. The motor and shipping container together weigh about 310 lbs. All forklifts and overhead hoists must be load (break) tested to at least 110% of this weight (i.e. 350 lbs.). This test must be performed prior to any handling of the BSM but does not need to be repeated until something other than the BSM is lifted by the same handling equipment. It is therefore recommended that

9-27-93

the break tests be performed each evening before the BSM testing commences. The break tests shall be performed as follows:

a. The proof load must be at least 350 lbs.

b. Lift the dummy load clear of the ground (less than 1 foot) and lower to ground three times, holding for five minutes on the third lift. Lifting straps and spreader bar should be attached during the lift.

SEE APPENDIX C FOR THE PROOF TEST INSPECTION SHEETS.

4.3 Move Procedure

4.3.1 After review and documented approval, a redline change to this procedure may be performed. Approval shall be by a minimum of Test Engineer.

4.3.2 As soon as possible after a test failure, a deviation from the specified test environment, or any other incident which affects the test or test item, MSFC will notify the authorized UT/CSD representative of the event verbally and will then generate a Test Procedure Deviation (NASA form 3959). A copy of the Test Procedure Deviation is presented in Appendix A. Photographs of any discrepancies shall also be taken.

5.0 Personnel Responsibilities

5.1 Weather

5.1.1 The MSFC TE is responsible for checking the weather conditions before the move. The test site's relative humidity must be above 20%. If the humidity is not above 20%, all move operations will be postponed until favorable weather conditions resume.

Test site relative humidity: 46% MSFC TE

5.1.2 It is not recommended to transport the motor in the rain. However, if the motor must be moved during the rain, cover the motor with Velostat sealed with conductive tape.

5.1.3 The MSFC TE shall check with the Army MET team to ensure that there is no lighting within 10 miles. (MET team phone number....876-2465). [✓]

9-27-93

5.1.4 If lightning is within 10 miles during any time that a live BSM is in building 4619, the MSFC TE shall make arrangements to disconnect the motor ground from the facility ground. The motor shall remain ungrounded until the lightning is out of range.

5.1.5 When reconnecting the ground after a lightning storm, a 100Kohm resistor should be connected to the ground wire from the motor before connecting to facility ground. This allows any charge on the motor to slowly dissipate to ground. The resistor should be left connected for no less than **30** seconds.

5.1.6 After the specified time, disconnect the ground wire from facility ground and remove the resistor. Reconnect the ground strap from the motor to facility ground.

5.2 **Move Witnessing**

The move will be witnessed by a minimum of the MSFC TE, MSFC SE, and the MSFC QA.

5.3 **The MSFC TE will serve as the area coordinator for the test. All handling of the BSM will be directed by the MSFC TE or cognizant test engineer.**

5.4 **Jim McGee (vibration) shall be responsible for photographic coverage of the move activities.**

5.5 **All involved lab directors and division chiefs shall be notified prior to testing.** [✓]

5.6 **The MSFC TE shall make arrangements for the live BSM to be transported from the vibration lab to the pyro lab.** [✓]

5.7 **The MSFC TE shall call security (4-4357) to arrange for a motor escort to the pyro lab.** [✓]

6.0 Transport Truck Preparation

6.1 The area around the outside of the pyro shock facility shall be secured before the live BSM is brought to the pyro shock test site. [✓]

Area secured? YES NO   MB MSFC TE
PYS MSFC SE

Comments: Motor was taken to igloo after pick-up in vibration.

9-27-97

6.2 Have a certified truck ready to transport the test item to the pyro test room. The truck's engine will be off and at least one wheel chocked. [✓]

Truck's wheel braked and chocked: MB MSFC TE

6.3 MSFC TE shall call security and arrange for an escort. [✓]

7.0 <u>Load Shipping Container onto Truck</u>

CAUTION: **Make sure the ground wire connecting the shipping container to facility ground is long enough to reach the bed of the truck. If not, switch to a longer strap. REMEMBER TO MAKE NEW GROUND BEFORE BREAKING THE OLD GROUND. Verify resistance as required.**

CAUTION: **Be careful not to disconnect the ground wire during this move.**

7.1 Use the fork lift to place the shipping container on the explosive certified truck. The MSFC TE shall designate someone to keep the ground wire out of the way during this move. [✓]

7.2 Attach a ground strap to the truck chassis and verify its resistance. Measure the resistance from the end of the ground strap to a location on the truck chassis right next to the ground connection. The reason for this check is to make sure that there is a good connection to the motor chassis. Resistance shall measure less than 1 ohm. [✓]

Resistance measured: 0.1 Ω MSFC QA RC

7.3 Attach the chassis ground strap to the shipping container. [✓]

7.4 Verify truck to shipping container ground. Measure resistance from right next to the chassis connection to the shipping container connection. Resistance shall measure less than one (1) ohm. [✓]

Resistance measured: 0.1 Ω MSFC QA RC

7.5 Disconnect the shipping container to test cell ground. [✓]

7.6 Secure the shipping container in the truck bed. [✓]

8.0 <u>Transport Motor to Pyro Area/Unload Motor From Truck</u>

8.1 The motor carrying truck and escort personnel shall follow the route provided in Figure 1 moving at a maximum speed of 10 m.p.h. ~~[ ]~~

Motor 1000734 was taken to pyro only to load motor 1000738. Both motors were taken to the 19/00 at this time. (i.e. Motor 1000734 was not unloaded for temp. storage in pyro.)
RYB 9-27-93 MB 09/27/93 RC 9-27-93 9-27-93

C-3

Pyl 9-27-95
MB 09/27/95
RL 9-27-97

8.2 Fork lift shall proceed to the point designated on Figure 1 as "destination." [ ]

8.3 Upon arrival at the destination, the truck will turn off its engine, engage the emergency brake, and chock at least one wheel. [ ]

Truck's wheel braked and chocked: ___________ MSFC TE

CAUTION: Make New Ground Before Braking Old Ground.

8.4 Attach a ground wire to the pyro facility ground and verify its resistance. Resistance shall measure less than 1 ohm. [ ]

Resistance measured ______ MSFC QA ______

8.5 Attach the ground wire to the motor shipping container. Verify the resistance (should measure less than 1 ohm). [ ]

Resistance measured__________ MSFC QA ______

8.6 Disconnect the ground strap between the motor and the truck chassis. [ ]

CAUTION: Be careful not to disconnect the ground wire during the following move.

8.7 Use the fork lift to remove the shipping container from the truck. The MSFC TE shall designate someone to keep the ground strap out of the way during unloading. [ ]

8.8 Place the shipping container near the center of the room. [ ]

8.9 Clear area. Close and lock the doors to the pyro facility. [ ]

8.10 ***All pyro shock operations shall not commence until the BSM motor has been removed.***

9.0 <u>Load Motor for Delivery to NASA Igloo</u>

9.1 Park truck outside the pyro room doors. Leave adequate space for fork lift maneuvering. [ ]

9.2 Turn off the truck's engine, engage the emergency brake, and chock at least on of the truck's wheels. [ ]

Truck braked and wheel chocked: ___________ MSFC TE

RL 9-27-93
RYL 9-29-97 MB 9/12/13

9.3 Attach a ground wire to the truck chassis and verify the resistance. The resistance should measure less than 1 ohm. [ ]

Resistance measured: __________ MSFC QA __________

CAUTION: Be careful not to disconnect the ground wire during the following move.

9.4 Use the fork lift to place the shipping container on the explosive certified truck. The MSFC TE shall designate someone to keep the ground wire out of the way during this move. [ ]

9.5 Attach ground wire from the truck chassis to the shipping container. Verify resistance with an ohm meter (should be less than 1 ohm). [ ]

Resistance measured: __________ MSFC QA __________

9.6 Disconnect the shipping container to facility ground wire. [ ]

9.7 Secure the shipping container in the truck bed for delivery. [ ]

9.8 Delivery truck may now exit. [ ]

10.0 **Post Test Verification**

The procedure delineated in the above document has been satisfactorily completed and :

a. All sequences in the procedure have been completed (or deleted by approved deviation)

b. All Procedure changes have been recorded and approved.

Submitted Verified by: Mat Bevill
Test Engineer

Date: 09/27/93

Motor serial number: 1000734

9-27-93

Appendix A

Test Procedure Deviation

Figure 1

TEST PROCEDURE DEVIATION		TCP NO.:
TEST ENGINEER:	QUALITY	DATE
REQUIREMENTS ENGINEER:	OTHER:	
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 1

TEST PROCEDURE DEVIATION		TCP NO.:
TEST ENGINEER:	QUALITY	DATE
REQUIREMENTS ENGINEER:	OTHER:	
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 1

TEST PROCEDURE DEVIATION

TEST ENGINEER:	QUALITY	TCP NO.:
REQUIREMENTS ENGINEER:	OTHER:	DATE
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 2

DEVIATION LOG

PROCEDURE ____________________ REVISION ____________________

DEV NO.	PAGE	PARA STEP	REASON/REMARKS	P/T	DATE	
					ISSUED	SIGNED

C-4

Appendix B

Figures

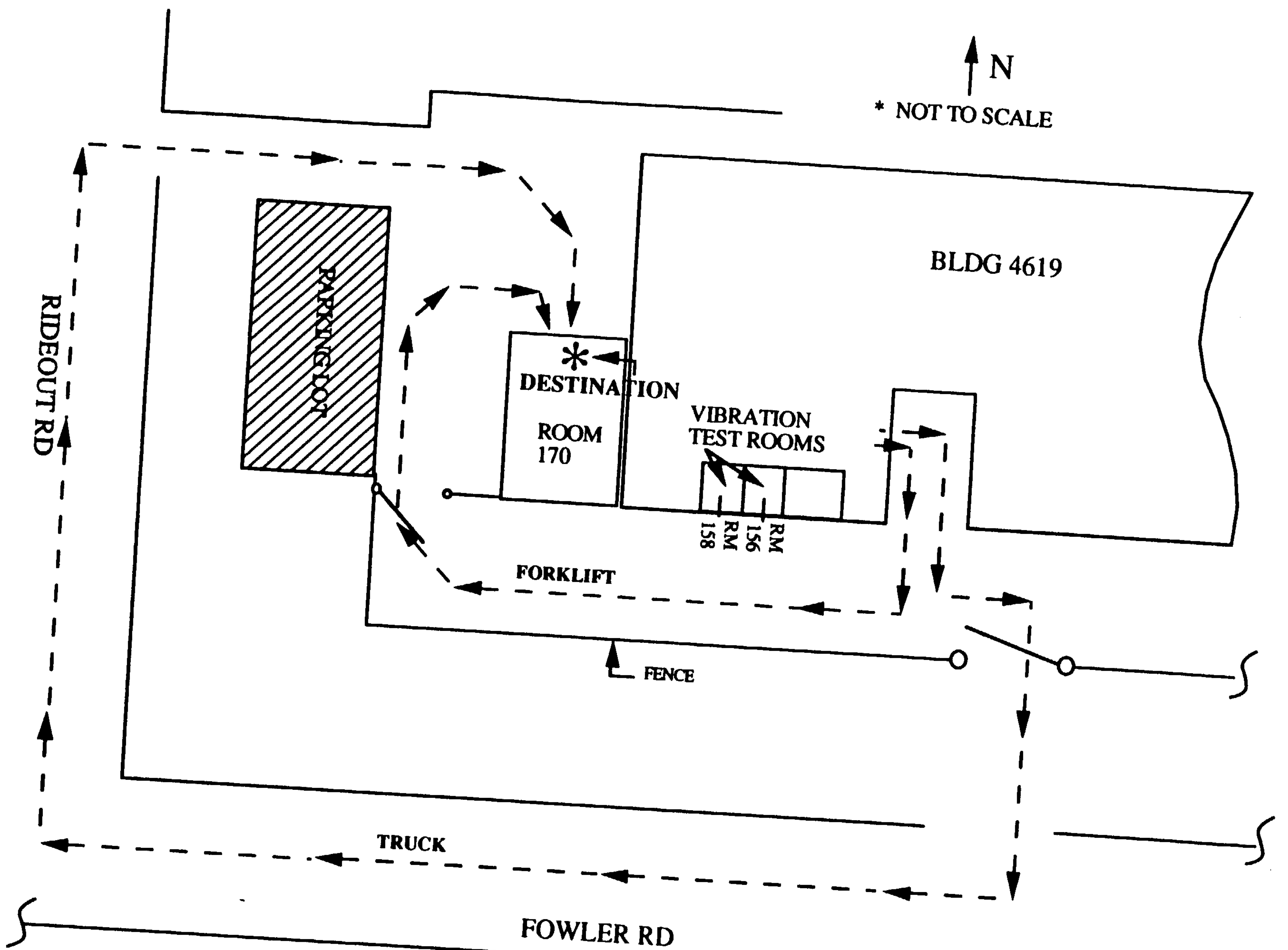


FIGURE 1. TRUCK ROUTE TO PYRO SHOCK AREA

Appendix C

Proof Test Inspection Sheet

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________

Forklift ____________ Driver ____________ Flagman ____________

Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________________ Date ____________

MSFC Safety ____________________ Date ____________

MSFC Quality ____________________ Date ____________

BSM MOTOR S/N 1000738

Appendix A

ED 73-SHK-FOP-004

FACILITY OPERATING PROCEDURE
FOR PYROTECHNIC SHOCK TESTS
ED73-SHK-FOP-004

PREPARED BY: J.B. Herring — 12/9/92
James Herring/ED73 — DATE
Test Engineer

PREPARED BY: Steve R Brewster — 12-9-92
Steve R. Brewster/ED73 — DATE
Team Leader

APPROVED: 12/10/92
C. ~~E.~~ Kirby/ED73 — DATE
Chief, Dynamics Test Branch

APPROVED: 12/10/92
Richard Leonard/CS01 — DATE
SAFETY

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this procedure is to define the steps necessary to perform a shock test in the Pyrotechnic Shock Facility in Building 4619 using blasting caps and mild detonating fuse (MDF) or flexible linear shaped charge (FLSC).

1.2 SCOPE

This document contains the steps to prepare the facility, conduct the test, and steps to follow in the event of misfires.

2.0 SAFETY

The operating policies set forth in EP01-SOP-01 "Standard Operating Procedure for Safety Critical Operations", shall be adhered to.

MSFC Medical Center	4-2390
Ambulance	122
Fire	117
Security	4-4357
Safety	4-0046

The Test Engineer will be responsible for personnel in the test activities and shall be notified immediately of any personnel activities.

3.0 APPLICABLE DOCUMENTS

EPT01-SOP-01, "Standard Operating Procedure for Safety Critical Operations"

ED73-SHK-SOP-006, "Safety Requirements and Procedures for the Operation of the Pyrotechnic Shock Facility"

AMC-R 385-100, Army Materiel Command Safety Manual

MM 1700.4, Safety and Environmental Health Standards

MMI 1710.6, MSFC Program for Personnel Certification

MMI 1710.1, Safety Review and Approval of MSFC Hazardous Activities

MMI 1845.1, Hazard Communication Program

NHB 1700.1(V1-A), Basic Safety Manual

DOD 6055.9, Ammunition and Explosives Safety Standard

0 GENERAL REQUIREMENTS

4.1 The Test Engineer will be in charge of all test preparations and activities.

4.2 All test activities shall be coordinated with the Test Engineer.

4.3 All changes to the procedure shall be coordinated with the Test Engineer.

0 ACCELEROMETER CALIBRATION

5.1 For each measurement location select an accelerometer of a type suitable for the amplitude expected. ____

5.2 Calibrate each accelerometer per ED73-SHK-FOP-008. ____

6.0 PRETEST FACILITY CHECKOUT

6.1 Verify that no flammable solvents, paints, gases, etc., are present in the hazardous area. ____

6.2 Verify that conductive floor mats are in place. ____

6.3 Verify floor mats and test, checkout, and assembly hardware are connected to the facility grounding system. ____

6.4 Verify the resistance of the conductive floor mats are less than 1 Ohm.
Recorded resistance reading ______________ Ohm ____

6.5 Verify that no leads are connected to the junction box terminals. ____

.6 Move junction box switch to "BULB" position. ____

6.7 Connect 12 Volts to the firing panel. ____

6.8 Insert firing key and verify panel meter indicates the correct voltage. ____

6.9 Switch key to "ARMED" position and verify power indicator light is illuminated. ____

6.10 Open red cover and flip firing switch, verify bulb on junction box lights. ____

6.11 Close red cover. ____

6.12 Switch key to "SAFE" position. ____

6.13 Move junction box switch to "METER" position. ____

6.14 Switch key to "ARMED" position and verify power indicator light is illuminated. ____

6.15 Open red cover and flip firing switch, verify that meter on junction box indicates 12 Volts. ____

6.16 Close red cover. ____

.17 Switch key to "SAFE" position and disconnect voltage source.

6.18 Remove firing key.

7.0 CHECKOUT, INSTALLATION, AND HOOKUP OF ORDNANCE

7.1 Verify Class 1.1 signs are posted on the outside walls of Room 170.

7.2 Verify that no severe weather or electrical storms are within 10 miles of the immediate vicinity.

7.3 Verify that no flammable solvents, paints, gases, etc., are present in the hazardous area.

7.4 Verify that conductive floor mats are in place.

7.5 Verify floor mats and test, checkout, and assembly hardware are connected to the facility grounding systems.

7.6 Verify the resistance of the conductive floor mats are less than 1 Ohm.
Recorded resistance reading ______________ Ohm

.7 Verify all non-essential personnel are clear of the test area.

7.8 Verify operational personnel are :

a. Wearing 100 percent cotton coveralls, shorts, undershirts, and socks, and street or safety shoes.

b. Remove all matches, lighters, jewelry, and all battery-powered devices such as electrical wrist watches, calculators; portable radios, etc.

7.9 During periods of connecting blasting caps, MDF, and FLSC, a maximum of two people (to be designated by the Test Engineer) will be permitted to remain in the area.

7.10 Verify that safety goggles, hearing protection, and wriststats or legstats are worn by personnel who will be installing explosive items.

7.11 Verify that the firing panel is in a "SAFE" condition and remove arming key from panel. The key is to be kept in the possession of the person installing the ordinance device.

.12 Turn on flashing light outside Room 170A.

7.13 Install required MDF or FLSC on exciter plate. ______

7.14 Verify switch on junction box is in "BULB" position. ______

7.15 Using a wrist strap checker, each person wearing a wrist strap shall check their wrist strap. ______

7.16 In Room 170B, verify that blasting cap shorting foil is in place and is undamaged before removing from storage container. ______

7.17 Remove blasting cap from storage container and transport to Room 170. ______

7.18 In Room 170, verify that wristats or legstats are in place. ______

7.19 Install blasting cap on exciter plate. ______

7.20 Press blasting cap shorting foil firmly against facility ground for 1 second. ______

7.21 In order to short the leads, slide enough shorting foil off blasting cap to attach an alligator clip. ______

7.22 Remove shorting foil: ______

7.23 Move switch on junction box to "BULB" position. ______

7.19 Verify that bulb on junction box is not illuminated. ______

WARNING:

IF BULB GLOWS, THERE IS SUFFICIENT RADIO FREQUENCY IN THE AREA TO POSSIBLY CAUSE DETONATION OF THE BLASTING CAP. THE CAP SHOULD BE LEFT SHORTED AND RETURNED TO ROOM 170B STORAGE CABINET. ALL BLASTING ACTIVITIES WILL BE CURTAILED UNTIL THE RF SOURCE IS REMOVED.

7.20 Move switch on junction box to "METER" position. ______

7.21 Verify 0 volts on meter. ______

WARNING:

IF VOLTAGE IS INDICATED, THE LINES TO THE FIRING PANEL ARE EITHER CONNECTED TO A VOLTAGE SOURCE OR ARE PICKING UP VOLTAGE FROM RADIATION CAUSED BY A NEARBY SOURCE. THE CAP SHOULD BE LEFT SHORTED AND RETURNED TO ROOM 170B STORAGE CABINET. ALL BLASTING ACTIVITIES WILL BE CURTAILED UNTIL THE VOLTAGE SOURCE IS REMOVED.

2 Move junction box switch to "BULB" position. ___

7.23 Install blasting cap leads in junction box, move switch to "FIRE" position and remove alligator clip. ___

7.24 Leave area, close door, and inform Test Engineer of status. ___

8.0 <u>DETONATION</u>

8.1 Test Engineer will insure that only essential personnel remain in Room 170A. ___

8.2 Prepare data acquisition system to acquire data. ___

8.3 Connect firing panel voltage supply and insert firing key, verify that meter indicates the appropriate voltage. ___

8.4 Start tape recorder. ___

8.5 Begin countdown. ___

8.6 On the count of 3, put switch in "ARMED" position, verify that power indicator is illuminated. ___

. On the fire command, open red cover and flip firing switch. ___

8.8 Turn the firing panel key to the "UNARMED" position. ___

8.9 Remove arming key and disconnect voltage supply. ___

NOTE:

IF BLASTING CAP DOES NOT FIRE, PROCEED TO SECTION 10.4
IF MDF OR FLSC SEGMENTS DO NOT FIRE, PROCEED TO SECTION 10.5

0 POST DETONATION

9.1 Wait a minimum of 5 minutes after firing before opening door to Room 170. ______

9.2 Turn off flashing light outside Room 170A. ______

9.3 Inform Test Engineer that door is to be opened. ______

9.4 In Room 170, move junction box switch to "BULB" position. ______

9.5 Remove blasting cap leads from junction box. ______

9.6 Inspect exciter panel to insure all explosive devices fired properly. ______

9.7 Verify all operational personnel are wearing wrist straps. ______

NOTE:

IF ALL EXPLOSIVE ITEMS DID NOT FIRE, GO TO EMERGENCY PROCEDURES, SECTION 10.0

'0.0 EMERGENCY PROCEDURES

.0.1 During Installation and Connection of Ordnance Items: Operational personnel shall immediately stop operations and evacuate the test area when:

a. A fire is reported in the immediate vicinity.
b. A fire or electrical short occurs in the test area.

Operational personnel shall immediately stop operations when:

a: When lightning is detected within 10 miles of the vicinity.
b: When severe weather is reported in the vicinity.
c: Loss of facility power in the test area.
d: Significant radio frequency disturbances exist in the vicinity.

Any such occurrence shall be immediately reported to the ED73 Test Engineer

.0.2 After Accidental Ordnance Detonation

The following actions shall be taken in the event of an accidental detonation of an ordnance device.

a. In the event of serious personnel injury, do no move the injured person unless necessary to prevent further serious injury.

b. Call ambulance (112) and/or fire department (117) if required.

d. Notify ED73 Test Engineer.

DO NOT TRY TO FIGHT ANY RESULTING FIRE IF THERE ARE OTHER ORDNANCE DEVICES IN THE AREA.

10.3 During Firing Countdown Operations

If evacuation of the area is directed by the ED73 Test Engineer:

a. Switch key to "SAFE" position, remove arming key, and disconnect firing panel power.

b. Evacuate the area as directed.

10.4 Blasting Cap Does Not Fire

10.4.1 Attempt to fire cap by closing "FIRE" switch and leaving engaged for 1 minute. Repeat a minimum of three times. If blasting cap fires, continue procedure at Section 9.0

10.4.2 Switch key to "SAFE" position, remove arming key, and disconnect firing panel power.

10.4.3 Wait 30 minutes before entering Room 170.

10.4.4 Put on safety goggles, hearing protectors, and wriststats.

10.4.5 In Room 170, move junction box switch to "METER" position.

10.4.6 Leave room and close door.

10.4.7 Connect firing panel power, insert arming key, and switch to "ARMED" position.

10.4.8 Open red cover and flip firing switch, verify voltage registers on junction box meter.

10.4.9 Switch key to "SAFE" position, remove arming key, and disconnect firing panel power.

10.4.10 Put on safety goggles, hearing protectors, and wriststats.

.4.11 In Room 170, move junction box switch to "ARMED" position. ______

10.4.12 Leave room and close door. ______

10.4.13 Increase voltage at power source by 50%. ______

10.4.14 Connect firing panel power, insert arming key, and switch to "ARMED" position. ______

10.4.15 Open red cover and flip firing switch. ______
If blasting cap fires, continue procedure at Section 9.0

10.4.16 Switch key to "SAFE" position, remove arming key, and disconnect firing panel power. ______

10.4.17 If blasting cap does not fire, wait 30 minutes before entering Room 170. ______

10.4.18 Obtain explosive misfire container. ______

10.4.19 Put on safety goggles, hearing protectors, and wriststats. ______

).4.20 In Room 170, move junction box switch to "BULB" position. ______

.0.4.21 Short blasting cap leads by twisting leads together and secure with an alligator clip. ______

10.4.22 Remove blasting cap by using mechanical devices ______

10.4.23 Place cap in explosive misfire container until turned over to Army for disposal. ______

J.5 <u>MDF/FLSC Segments Do Not Fire After Blasting Cap Detonation</u>

10.5.1 Switch key to "SAFE" position, remove arming key, and disconnect firing panel power. ____

10.5.2 Test Engineer will insure that no one enters Room 170 for a period of 1 hour after blasting cap detonation. ____

10.5.3 At the end of the required waiting period, put on safety goggles, hearing protectors, and wriststats. ____

10.5.4 In Room 170, examine explosive to determine if it is feasible to detonate by use of another blasting cap. ____

If another blasting cap may be used, continue procedure at Section 7.10.

10.5.5 Obtain explosive misfire container. ____

10.5.6 Use mechanical devices to remove explosive and place in explosive misfire container. ____

Appendix B

Test Procedure Deviation

Figure 1

TEST PROCEDURE DEVIATION		TCP NO.:
.ST ENGINEER:	QUALITY	DATE
REQUIREMENTS ENGINEER:	OTHER:	
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

RIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Appendix C

Figures

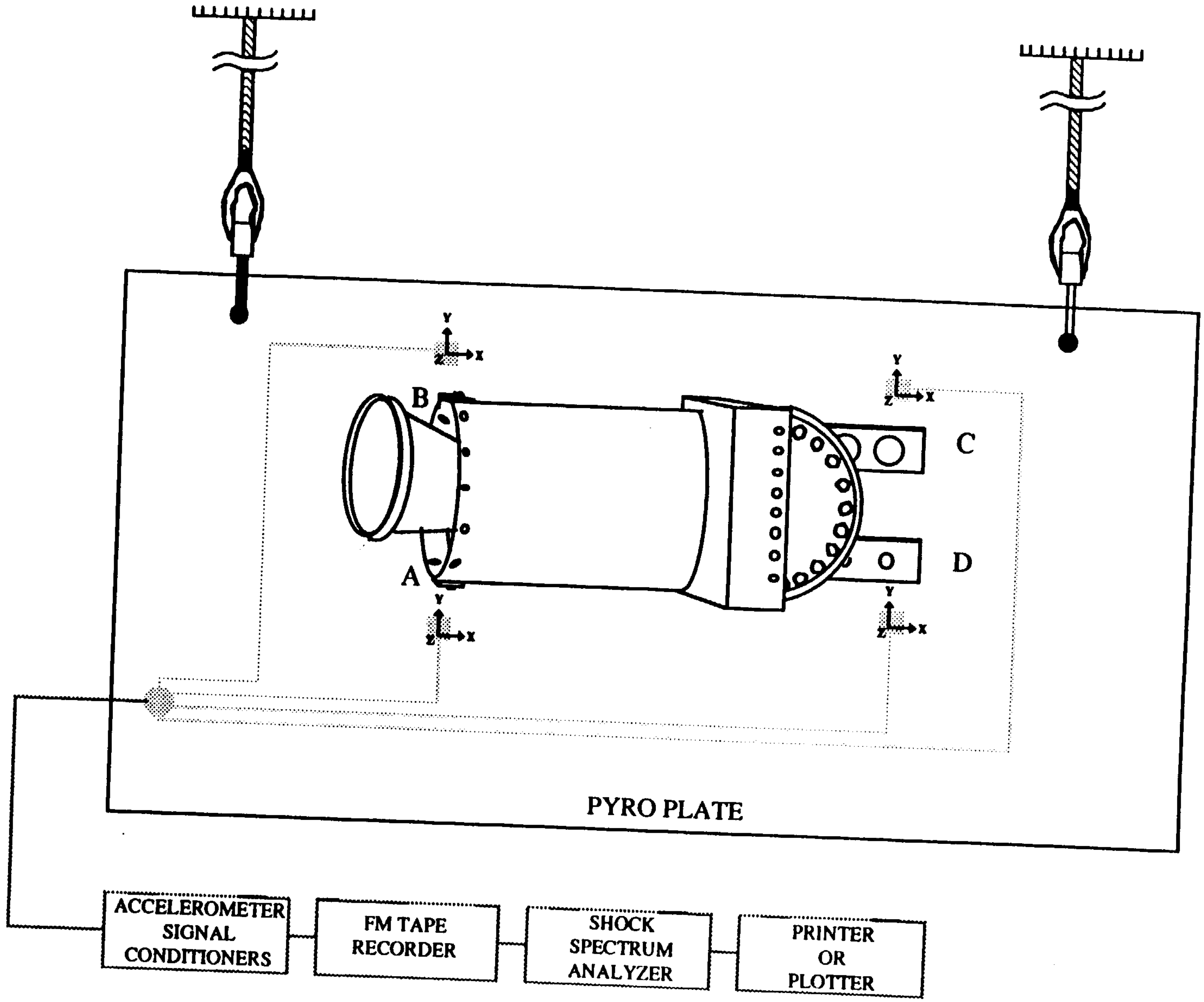


FIGURE 1. PYRO SHOCK CONTROL EQUIPTMENT

DRAWN BY :
K.MITCHELL / EP54
4/15/93

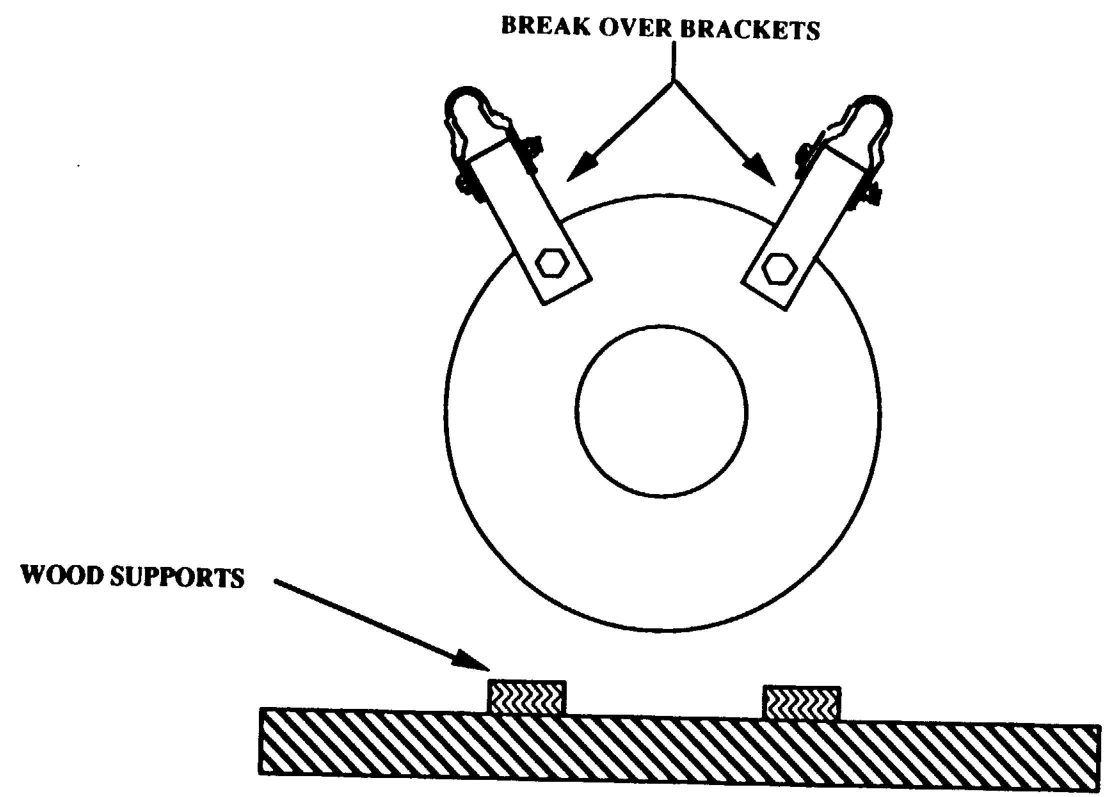


FIGURE 2. BREAK OVER BRACKET ASSEMBLY

DRAWN BY:
K.MITCHELL / BP54
3/8/93

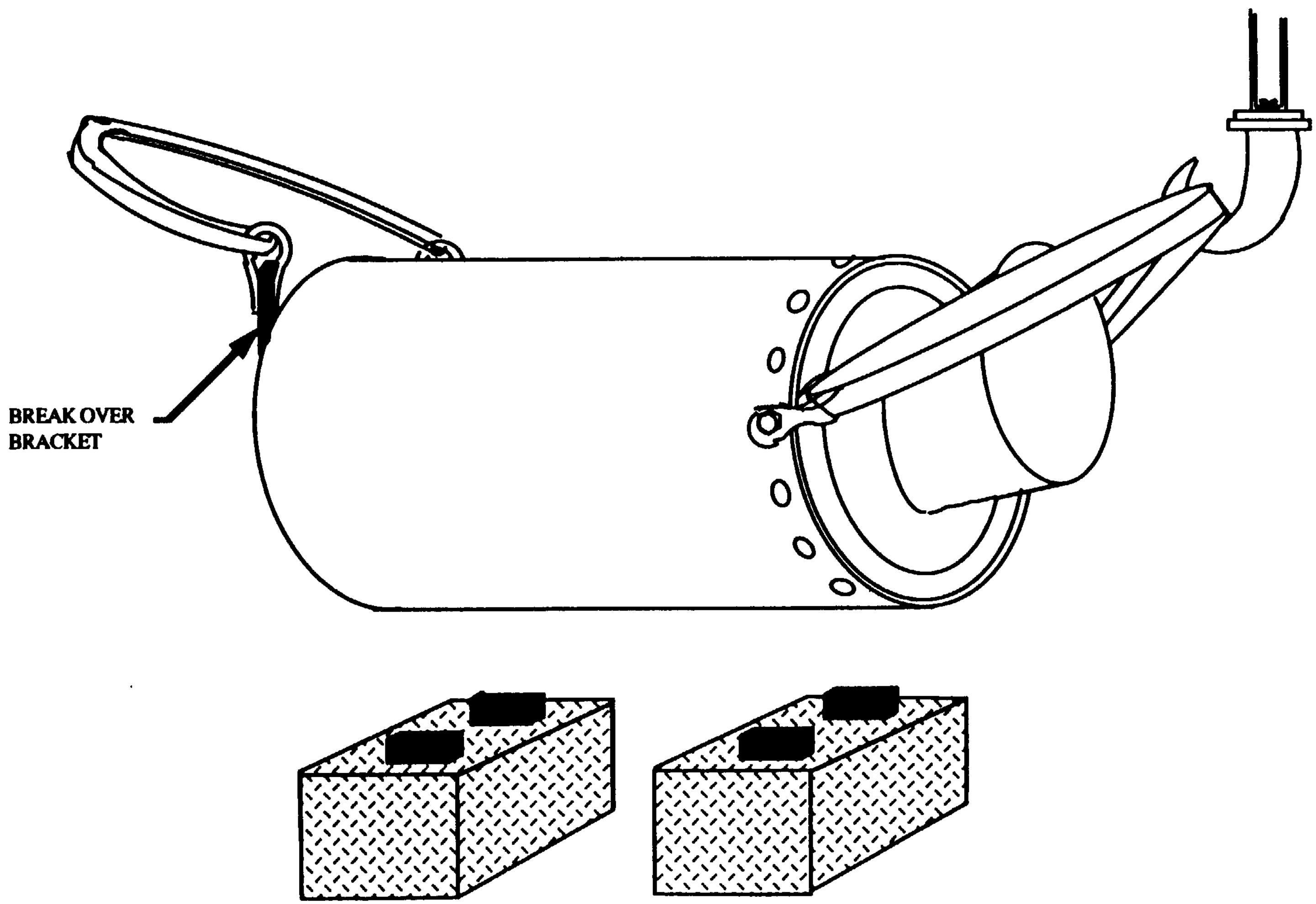


FIGURE 3. HORIZONTAL BREAKOVER

DRAWN BY :
K.MITCHELL / EP54

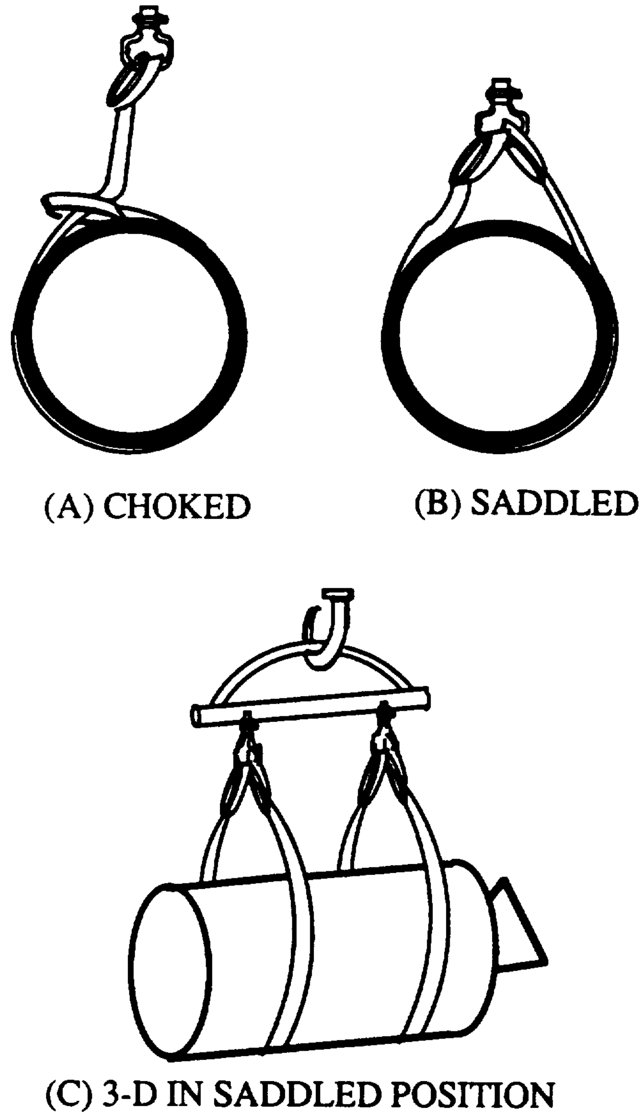


FIGURE 4. LIFTING STRAP ATTACHMENTS

DRAWN BY:
K. MITCHELL/EP54
3/8/93

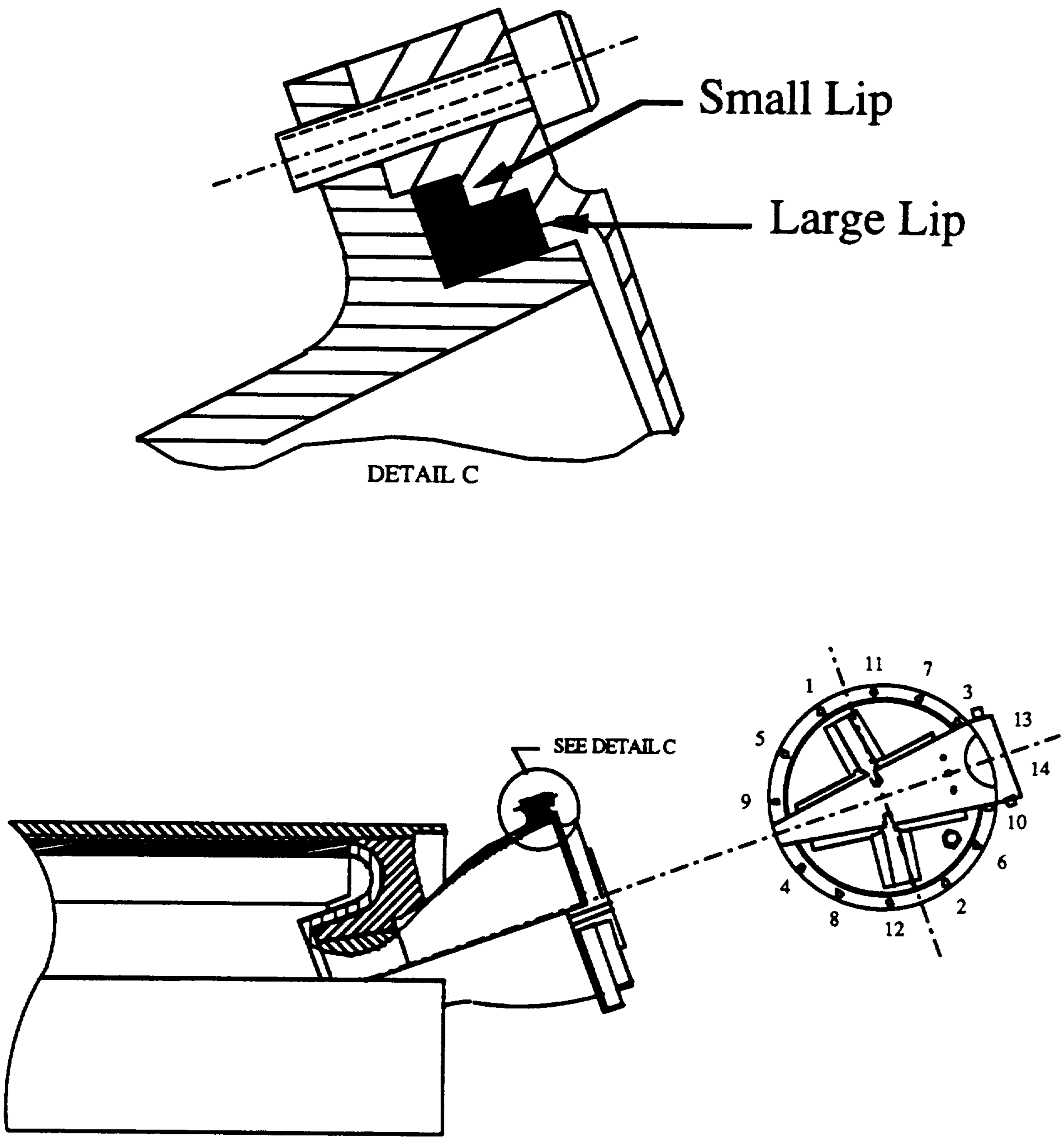


FIGURE 5. AERO HEAT SHIELD SEAL

DRAWN BY:
K. MITCHELL
4/9/93

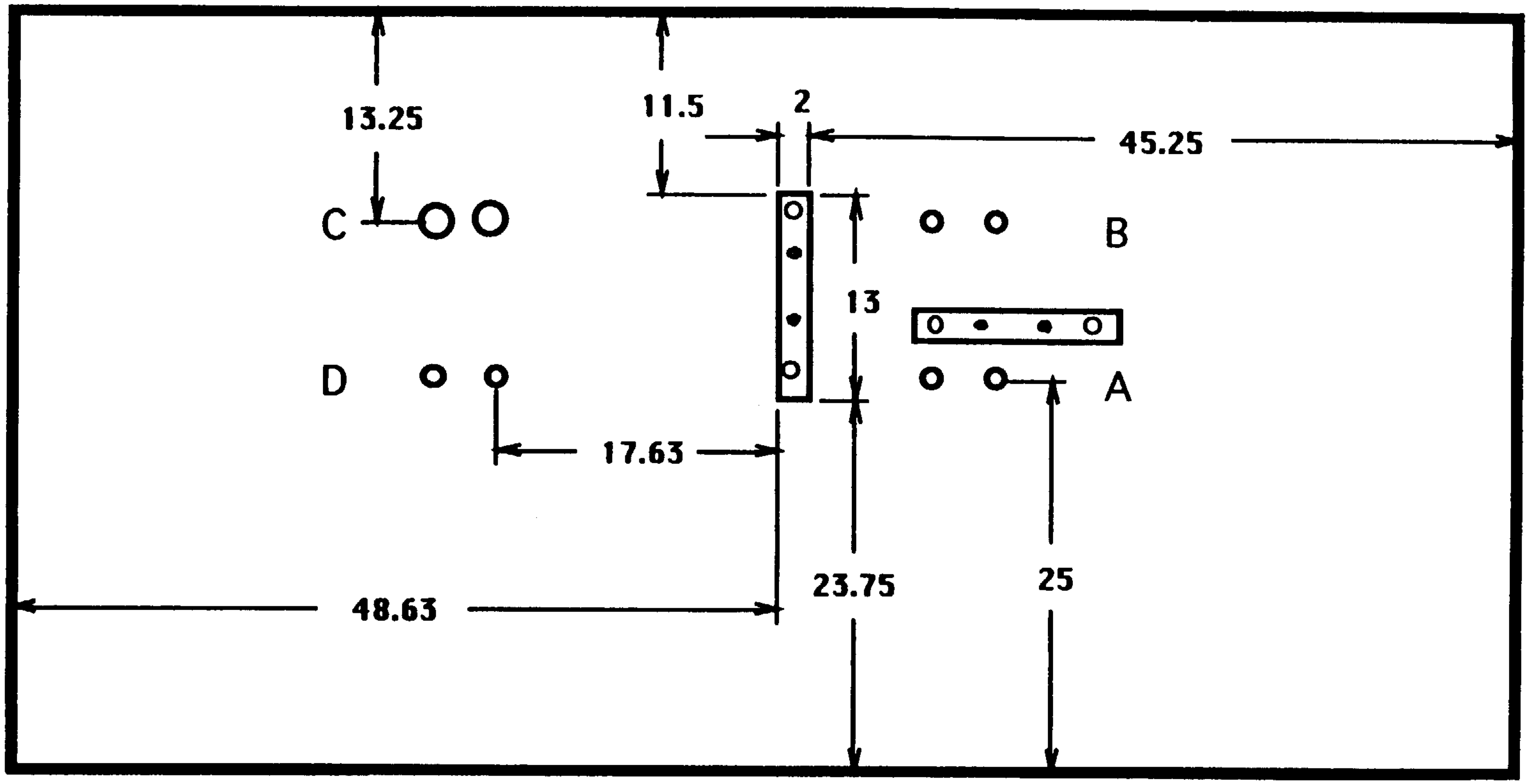


FIGURE 6. LOCATION OF BARS

* DIMENSIONS ARE IN INCHES

DRAWN BY:
K.MITCHELL/BP12
9/9/93

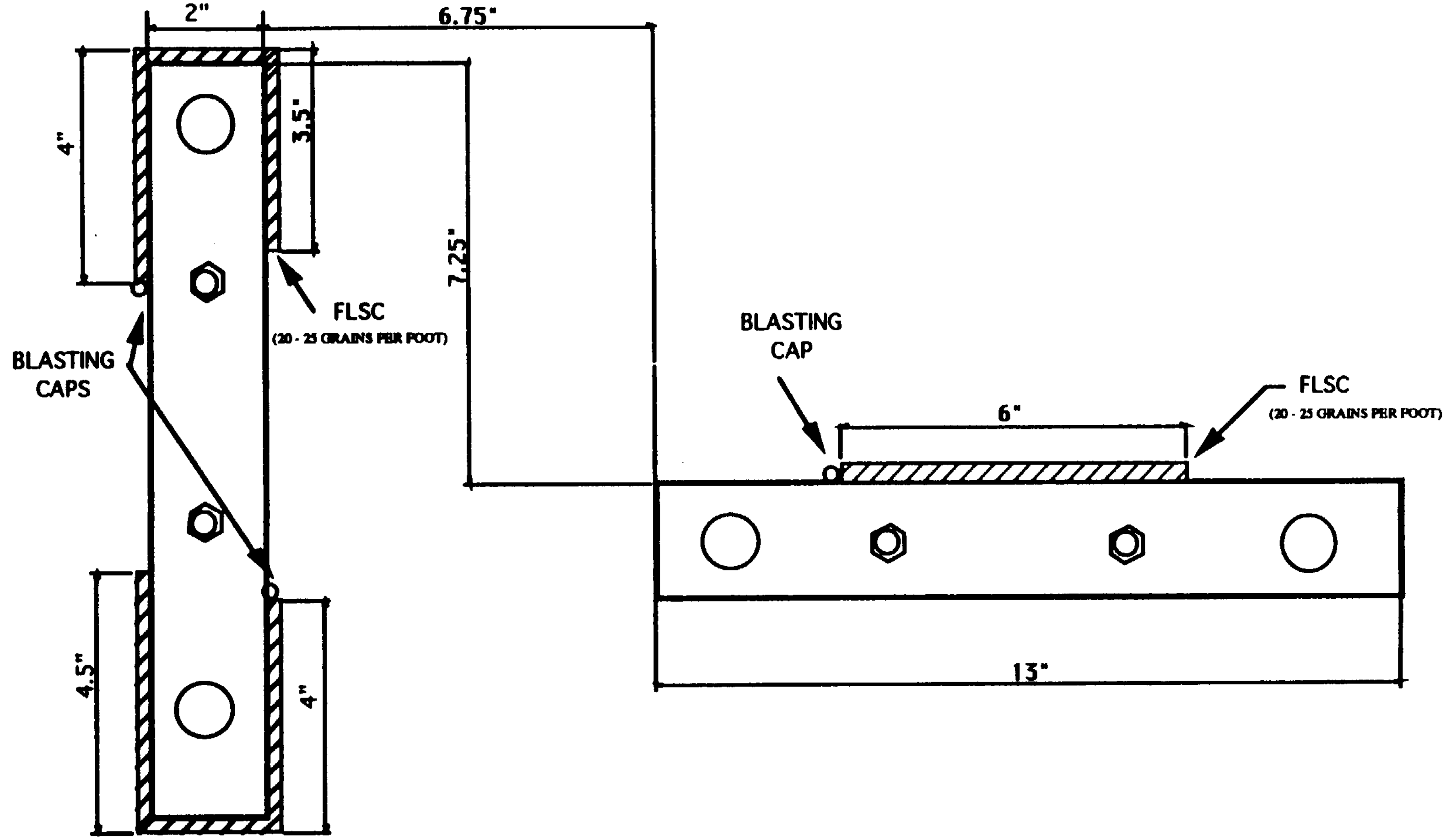


FIGURE 7. FLSC CONFIGURATION

DRAWN BY:
K.MITCHELL / EP12
9/9/93

Appendix D

Tool List

TORQUE WRENCHES:

Torque	Drive	Cal. Due	SN	Use	Owner
250 ft - lbs	1/2"	01/20/94	EMJ00359	Pos. C Bracket	Bill S.
100 ft - lbs	3/8"	10/05/93	BTW-2RCF	A, B, D, Bracket	McGee
25 in - lbs	3/8"	10/05/93	5492304	AHS Fasteners	McGee
750 in - lbs	3/8"	??????	T-267-GL	Ship. Cont. Grnd.	McGee
150 in - lbs	3/8"	08/24/93	52117		McGee
100 ft - lbs	1/2"	10/05/93	7011013		McGee

RATCHETS

1/2" drive
3/8" drive

HANDLES

1/2" drive (long)
3/8" drive
1/4" screwdriver handle
1/4" slide handle

SOCKETS

Size	Drive	Type
3/4"	1/2"	regular
	3/8"	regular
	1/2"	deep well
5/8"	1/2"	regular
	1/2"	deep well
25/32"	1/2"	deep well
11/16"	3/8"	regular
	3/8"	deep well
	3/8"	regular-elbow
1/2"	3/8"	regular
	3/8"	deep well
9/16"	3/8"	regular

1/4"	1/4"	regular (AHS)
3/8"	3/8"	regular

ADAPTERS AND EXTENSIONS

Size	Type
1/2" to 1/2"	extension
1/2" to 3/8"	extension
3/8" to 3/8"	extension
3/8" to 1/2"	adapter
3/8" to 1/4"	adapter
3/8" to 3/8"	adapter (elbow)

ALLEN HEAD SOCKETS

1/2" drive to 9/16"
1/2" drive to 1/2"
1/2" drive to 3/8"
3/8" allen
3/8" allen (cut-off)

BOX END AND OPEN END WRENCHES

11/16" box end
9/16" box end
1/2" box end

1/2" open end

OTHER TOOLS

Pipe extension

Special wrenches for inspection plate nuts

Appendix E

Proof Load Inspection Sheets

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature: Booster Separation motor

b. SN: 1000738

2. Handling Procedure Number

BSM-TCP-EP54-001

3. Location of Lift (Fac. Bldg.)

a. Building: 4619 North 2-ton crane, rm 170 S/N RR135

b. Date of lift: 09/20/93

4. Weight to be Lifted (in lbs.)

a. Item: 310 (in ship container)

b. Hoisting Equipment 20

c. Total: 330

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records X
2. Equipment tagged with appropriate max working loads X
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured X
4. Assessment prior to critical lift complete per MSFC-STD-126E X

b. Operator's Certification Validation:

Crane PAT McCARRICK Rigger PAT McCARRCK Flagman ______

Forklift PAT McCARRCK Driver ______ Personnel Hoist ______

c. Visual inspection shows no evidence of damage, excessive wear or abuse. OK

d. Dummy load lift of 500 lbs. completed and no discrepancies noted. ______

6. For additional information, observations and remarks

______

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager [signature] Date 9/20/93

MSFC Safety [signature] Date 9/20/93

MSFC Quality [signature] Date 9/20/93

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature: Booster Separation Motor

b. SN: 1000738

2. Handling Procedure Number

BSM-TCP-EP54-001

3. Location of Lift (Fac. Bldg.)

a. Building: 4619 Rm 170 South Crane SNRR136

b. Date of lift: 9/20/93

4. Weight to be Lifted (in lbs.)

a. Item: 310

b. Hoisting Equipment 20

c. Total: 330

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records — X
2. Equipment tagged with appropriate max working loads — X
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured — X
4. Assessment prior to critical lift complete per MSFC-STD-126E — X

b. Operator's Certification Validation:

Crane Pat McCarrick Rigger Pat McCarrick Flagman ______

Forklift Pat McCarrick Driver ______ Personnel Hoist ______

c. Visual inspection shows no evidence of damage, excessive wear or abuse. — ok

d. Dummy load lift of 500 lbs. completed and no discrepancies noted. — ✓

6. For additional information, observations and remarks

______

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager [signature] Date 9/20/93

MSFC Safety [signature] Date 9/20/93

MSFC Quality [signature] Date 9/20/93

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature: Booster Separation Motor

b. SN: 1000738

2. Handling Procedure Number

BSM-TCP-EP54-001

3. Location of Lift (Fac. Bldg.)

a. Building: 4619 rm 170 Forklift MSFC 2340

b. Date of lift: 09/20/93

4. Weight to be Lifted (in lbs.)

a. Item: 310

b. Hoisting Equipment: 20

c. Total: 330

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records — X
2. Equipment tagged with appropriate max working loads — X
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured — X
4. Assessment prior to critical lift complete per MSFC-STD-126E — X

b. Operator's Certification Validation:

Crane Pat McCarrick Rigger Pat McCarrick Flagman ______

Forklift Pat McCarrick Driver ______ Personnel Hoist ______

c. Visual inspection shows no evidence of damage, excessive wear or abuse. — OK

d. Dummy load lift of 500 lbs. completed and no discrepancies noted. — ✓

6. For additional information, observations and remarks

______

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager [signature] Date 9/20/93

MSFC Safety [signature] Date 9/20/93

MSFC Quality [signature] Date 9/20/93

National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center. Alabama 35812

BSM-TCP-EP54-002

BSM Delta Qualification Test

Move BSM from Pyro to Vibration / Setup Thermal Conditioning

This Procedure Describes **Safety Critical** Operations

BSM-TCP-EP54-002

BSM Delta Qualification Test

Move BSM from Pyro to Vibration / Setup Thermal Conditioning

Prepared by:

Mat Bevill EP-12

08/16/93

Motor SN: 1000 738

Test Date: 09/21/93

Move BSM from Pyro to Vibration / Setup Thermal Conditioning

Prepared by:

Mat Bevill

Mat Bevill/MSFC TE/EP12 — 9/15/93 Date

Approved by:

Jim McGee

Jim McGee/MSFC Vibration Lab TE — 9-14-93 Date

Jim Herring

Jim Herring/MSFC Pyro/Shock Lab TE — 9-14-93 Date

Richard Y Leonard

Richard Leonard/MSFC Safety/CS01 — 9-16-93 Date

Rick Clements

Rick Clements/MSFC Quality/CQ06 — 9-15-93 Date

Ben Goldberg/Motor Systems Division/EP11 — 9/14/93 Date

Steve Brewster/Dynamic Test Branch/ED73 — 9/14/93 Date

Charles E. Wells

Chuck Wells/UTC/CSD TE — 9/16/93 Date

Donald Wencil

Don Wencil/USBI — 9-14-93 Date

Charles W. Lovell

Charlie Lovell/PCH Engineer/CN71 — 9/16/93 Date

Move BSM from Pyro to Vibration / Setup Thermal Conditioning

Prepared by:	Mat Bevill Mat Bevill/MSFC TE/EP12	09/15/93 Date
Approved by:	Jim McGee Jim McGee/MSFC Vibration Lab TE	9-14-93 Date
	Jim Herring Jim Herring/MSFC Pyro Shock Lab TE	9-14-93 Date
	Richard Y Leonard Richard Leonard/MSFC Safety/CS01	9-16-93 Date
	Rick Clements Rick Clements/MSFC Quality/CQ06	9-15-93 Date
	Ben Goldberg/Motor Systems Division/EP11	9/14/93 Date
	Steve Brewster/Dynamic Test Branch/ED73	9/14/93 Date
	Chuck Wells/UTC/CSD TE	Date
	Donald Wencil Don Wencil/USBI	9-14-93 Date
	Charles W. Lovell Charlie Lovell/PCH Engineer/CN71	9/16/93 Date

Table of Contents

1.0 General Information

1.1 Scope

This test procedure addresses all the requirements to perform the move of the BSM from the pyro test facility to the vibration test facility along with the thermal conditioning setup for the Radial Axis vibration test.

1.2 Objective

The objective of the dynamic testing is to verify the physical and functional survivability of the Booster Separation Motors. Of particular interest for these tests are the components bonded using EA9394 adhesive. The components using this adhesive include the throat insert, the centering insert, and the igniter grain support rod.

2.0 Applicable Documents

MSFC-STD-513A	Certification of Equipment Operations and Materials Handling Personnel
EG5300.36A	Safety
29 CFR 1910	Occupational Safety and Health Administration (OSHA)
NSS/GO 1740.9	Safety Standard for Lifting Devices and Equipment
NHB 1700.1(V1)	Basic Safety Manual
AMC-R 385-100	Safety Manual
EP01-SOP-01	Standard Operating Procedure for Safety Critical Operations
MM 1700.4	Safety and Environmental Health Hazards
MMI 1700.17	MSFC Procedures for Acquiring Shipping Permits for Rocket Motors and Igniters
MMI 1710.1	Safety Review and Approval of Hazardous and Potentially Hazardous Facilities and Activities at MSFC
MMI 1710.6	MSFC Program for Personnel Certification
MMI 1711.2	Mishap Reporting and Investigation

MMI 1845.1	Hazard Communication Program
MMI 6400.2	Packaging, Handling, and Moving Program Critical Hardware
MSFC-RQMT-1493	Electrostatic Discharge Control Requirements
MSFC-STD-1800	Electrostatic Discharge (ESD) Control for Propellant and Explosive Devices
MSFC-STD-126E	Inspection, Maintenance, Proof Testing and Certification of Handling Equipment
CSD-5597-93-1 Rev. B	Enhanced Delta Qualification Test Plan for Booster Separation Motor (BSM), Aug. 6, 1993
10SPC-0067 Rev. A	Specification for Booster Separation Motors for Space Shuttle Solid Rocket Booster (thru SCN 014)

3.0 Safety

3.1 The following safety criteria are in accordance with ET01-SOP-01, Rev. A., *Standard Operation Procedures for Safety Critical Operations".* If safety rules/regulations are not followed,injury to personnel and/or damage to test items could occur.

Emergency telephone numbers are as follows:

Safety	4-0046
Ambulance	112
Fire	117
Security	4-4357
Utilities	4-3919
Medical Center	4-2390
Communication Repair	4-1771

3.2 Prior to starting work in 4619 a visual inspection of the work area shall be made for anomalies by task supervisor and safety personnel.

MSFC TE MB MSFC SE RJ

Date / Time: 09/21/93 12:50 a.m.

3.3 Personnel shall not work or position themselves beneath suspended loads unless such loads are securely and adequately blocked up.

9-21-93

3.4 Objects handled by overhead hoist shall be lifted only high enough to clear fixed objects in the path of travel. Spreader bars and slings may be left on the hoist if desired when not in use, but must be raised so that the lowest part of the lifting equipment will be at least seven feet from the floor when not in use.

3.5 Crane, hoist, lift prime operators, and riggers shall be certified according to the latest revision of MMI 1710.6, and shall have in their possession a valid certification card.

Certifications checked by: MB

Date / Time: 09/21/93

3.6 Personnel working around suspended loads shall be alert to the possibility of being crushed between the suspended load and a fixed object.

3.7 Loads shall be moved slowly so they will not accumulate more momentum than can be stopped with little or no swing.

3.8 Where handling slings are called out, a sling with more pickup points than required may be used if the weight capacity per point used is equal or greater than the weight capacity of each point of the noted sling and the free pickup point is (are) secured to prevent it (them) from swinging and causing damage to parts.

3.9 Only the area coordinator should direct the crane moves, however, any person determining an immediate danger or problem may request stoppage of activities.

3.10 The lifting or transportation operation shall be halted by the area coordinator at any time the control area cannot be maintained.

3.11 Steel toe shoes are required during lifting operations. Hardhats are required when the lift is at or above the shoulders.

3.12 Tag line operators are to wear leather gloves.

3.13 The primary safety hazards associated with this operation are:

3.13.1 Lift operations
3.13.2 Solvent Use (See NOTE)
3.13.3 Live (Loaded) Solid Rocket Motor

9-21-93

NOTE: Grease and solvent use are only "if needed" as determined by the MSFC TE and CSD TE.

3.14 Any time a crane is being used, it must be dogged if:

3.14.1 The load will be suspended in a static condition for an extended amount of time.

3.14.2 A crane operator crew change or substitution must be made.

3.15 No electric power tools shall be used near the live test item. Use of pneumatic tools is acceptable.

3.16 All ground cables and ground straps end-to-end resistances shall be verified with a multimeter. These resistances must measure less than 1 ohm.

3.17 All personnel within touching distance of the BSM or ordnance shall wear a wrist strap that has been checked with a wrist strap checker. This step should be performed each time the wrist strap ground is broken.

3.18 All personnel within touching distance of open grain propellant (and ordnance) shall wear antistatic coveralls.

4.0 Test Items and Test Requirements

4.1 Test Items

The test item for the delta qualification vibration tests consists of a live BSM which will be tested in the aft motor configuration. The motor will be tested with an aero heat shield over the exit cone. The motor weighs approximately 154 pounds each.

4.2 Test Requirements

4.2.1 Test Tolerances

Unless otherwise stated in this procedure, the tolerances applicable to the test conditions described shall be as specified in MIL-STD-810D. These tolerances are as follows:

Temperature: $\pm 5°$ F

4.2.2 Test Data

All data taken with non-recording instruments will be recorded in ink directly onto data sheets and/or log sheets. The log or data sheets will identify the test being performed, the test item, the item part number, and the applicable test procedure. Corrections or changes will be made by drawing a single line through the original entry. The new entry will be made directly above the old and initialed by the person making the entry. Each page will be signed and dated at the bottom of the page by the person making the entries, and counter signed by the test engineer after review.

4.3 Test Conditions

The live delta qualification motor will be vibration tested at a specific temperature. The motor will be either be tested at 25°F or at 125°F depending on which motor is controlled by this procedure.

4.3.1 The MSFC TE is responsible for checking the weather conditions before the move. The test site's relative humidity must be above 20%. If the humidity is not above 20%, all move operations will be postponed until favorable weather conditions resume. [✓]

Test site's relative humidity: 97% MSFC TE MB

4.3.2 The MSFC TE shall check with the Army MET team to ensure that there is no lighting within 10 miles. (MET team phone number....876-2465). [✓]

4.3.2.1 If lightning is within 10 miles during any time that a live BSM is in building 4619, the MSFC TE shall make arrangements to disconnect the motor ground from the facility ground. The motor shall remain ungrounded until the lightning is out of range.

4.3.2.2 When reconnecting the ground after a lightning storm, a 100Kohm resistor should be connected to the ground wire from the motor before connecting to facility ground. This allows any charge on the motor to slowly dissipate to ground. The resistor should be left connected for no less than 30 seconds.

4.3.2.3 After the specified time, disconnect the ground wire from facility ground and remove the resistor. Reconnect the ground strap from the motor to facility ground.

9-21-93

4.3.3 It is not recommended to transport the motor in the rain. However, if the motor must be moved in the rain, it should be wrapped in Velostat and sealed with conductive tape.

4.4 Test Equipment

4.4.1 All measurements shall be made with instruments and equipment whose accuracy and/or calibration has been verified.

Calibration Acceptable____MB____(MFSC TE)

4.4.2 Proof Loading of Handling Equipment (required for PCH)

4.4.2.1 The heaviest lift during all of the delta qualification testing will be lifting the motor while in its shipping container. The motor and shipping container together weigh about 310 lbs. All forklifts and overhead hoists must be load (break) tested to at least 110% of this weight (i.e. 350 lbs.). This test must be performed prior to any handling of the BSM but does not need to be repeated until something other than the BSM is lifted by the same handling equipment. It is therefore recommended that the break tests be performed each evening before the BSM testing commences. The break tests shall be performed as follows: [✓

a. The proof load must be at least 350 lbs.

b. Lift the dummy load clear of the ground (less than 1 foot) and lower to ground three times, holding for five minutes on the third lift. Lifting straps and spreader bar should be attached during the lift.

SEE APPENDIX B FOR THE PROOF TEST INSPECTION SHEETS.

4.5 Procedure for the Move and Setup

4.5.1 After review and documented approval, a redline change to this procedure may be performed. Approval shall be by a minimum of the MSFC TE, MSFC SE, and the MSFC QA.

4.5.2 As soon as possible after a test failure, a deviation from the specified test environment, or any other incident which affects the test or test item, MSFC will notify the authorized UT/CSD representative of the event verbally and will then generate a Test Procedure Deviation (NASA form 3959). A copy of the Test Procedure Deviation is presented in Appendix A. Photographs of any discrepancies shall also be taken.

9-21-93

5.0 **Personnel Responsibilities**

5.1 **Test Witnessing**

All tests will be witnessed by the authorized UT/CSD representative and USBI representative. The MSFC test engineer will also witness the testing (moving and setup). Notification of the start of the move shall be communicated to the authorized UT/CSD and USBI representatives and the MSFC safety representative and test engineer at least 2 hours in advance.

MSFC Safety Notified MB

UT/CSD Notified MB

5.2 **The MSFC TE will serve as the area coordinator for the test. All handling of the BSM will be directed by the MSFC TE or cognizant test engineer.**

5.3 **Jim McGee (vibration) and Jim Herring (pyro) shall be responsible for photographic coverage of the test activities .**

5.4 **All involved lab directors and division chiefs shall be notified prior to testing.** [✓]

5.5 **The MSFC TE shall make arrangements for the live BSM to be transported from the pyro lab to the vibration lab.** [✓]

5.6 **The area around the outside of the vibration facility shall be secured *before* the live BSM is brought from the pyro shock test site. This area should also be clear so that the transport truck can drive to the vibration lab doors.** [✓]

Area secured? YES NO MB MSFC TE
PH MSFC SE

Comments: Doors locked

6.0 **Move BSM from Pyro Shock Area to the Vibration Test Area**

6.0.1 Fire symbol 3 shall be used when the motor is in the vibration test rooms. [✓]

9-21-93

Grounding.

Motor was immediately connected to facility ground (100 ft strap). The ground connecting motor to other ground (under shock was then disconnected. The motor was then taken to the truck. the strap that connected the motor to the ground under the plate was left connected and used to connect to the truck.

NB 09/21/93
RC 9-21-93
TYS 9-21-93

6.1 Take the Test Item to the Vibration Test Room

6.1.1 Have a certified truck ready to transport the test item to the vibration test room. The truck's engine will be turned off and at least one wheel chocked. [✓]

CAUTION: Make New Ground Before Braking Old Ground.

6.1.2 The MSFC TE shall call security (4-4357) to arrange for a motor escort to the vibration lab. [✓]

6.1.3 Attach a ground wire to the truck chassis and verify its resistance. Resistance shall measure less than 1 ohm. See opp. page. [✓]

Resistance measured ________ MSFC QA ________

CAUTION: Exercise care not to entangle or tug on the motor grounding strap during the following lifting operation.

6.1.4 **SLOWLY** lift the motor and pallet using the certified fork lift and load into the truck bed. Secure the pallet to the truck bed. [✓]

6.1.5 Attach the ground strap from the truck chassis to the motor case. [✓]

Verify resistance between motor case and truck chassis (<1 ohm):

Resistance measured: 0.1 Ω MSFC QA RC

6.1.6 Disconnect the motor to test cell ground. [✓]

6.1.7 Upon arrival of escort , the motor carrying truck and escort personnel shall follow the route provided in Figure 1 moving at a maximum speed of 10 m.p.h. [✓]

6.1.7.1 Fork lift shall proceed to the point designated on Figure 1 as "destination." The fork lift should carry the pallet containing the empty shipping container and place it near the entrance to the longitudinal axis vibration test room. [✓]

6.1.7.2 MSFC TE shall make sure that the necessary hardware and materials are transported to the vibration test room. [✓]

6.1.8 Upon arrival at the destination, the truck will turn off its engine and chock at least one wheel. [✓]

6.1.9 Attach a long ground wire to facility (vib.) ground and verify its resistance. Resistance shall measure less than one (1) ohm. [✓]

Resistance measured: 0.1 Ω MSFC QA RC

9-21-93

6.1.10 Attach the free end of this ground wire to the motor and verify its resistance. Resistance shall measure less than one (1) ohm. [✓]

Resistance measured: 0.2 Ω MSFC QA RC

6.1.11 Remove motor to chassis ground. [✓]

CAUTION: Be careful not to disconnect the ground wires during the following moves.

Step was performed 6.1.12 Use the forklift to place the motor and the pallet directly beneath the overhead crane in room 156, building 4619. Fork lift not grounded STET NB 09/21/93 RC N/A

6.1.13 Disconnect the ground between the fork lift and facility ground. The fork lift may now exit the immediate area. N/A RC

6.1.14 Remove the attach bolts between the support brackets and the pallet. Place the attach bolts in a labeled bag. [✓]

6.1.15 Leave the doors that enter the high bay open while handling the BSM. [✓]

7.0 <u>Thermal Conditioning for Radial Axis Test Setup</u>

7.0.1 Unless otherwise stated by the MSFC TE, all personnel related to this test shall stay in the vibration control room during the test set-up and actual tests. [✓]

7.0.2 <u>Bare Test Fixture Run</u> [✓]

At the discretion of the vibration test supervisor, perform a bare fixture or bare headplate/slipplate equalization run for the first test spectrum in each of the test axes, just prior to mounting the test specimen or after each axis change. This procedure will verify that the vibration control system is set up properly and that the vibration spectrum is within the tolerances specified in paragraph 4.2.1.

Bare fixture run performed: yes ✓ no ____

Comments: ~~Br~~ Fixture run on 09/17/93

7.1 Radial Axis Test Setup

7.1.1 <u>General Information</u>

The vibration control equipment shall be installed as shown in Figure 2, and verify that the equipment calibrations are current. MSFC will provide adapter plates to accommodate the UT/CSD supplied [✓]

9-21-93

test fixture. The BSM will be mounted on the test fixture in the aft motor configuration. Reference Figure 3 for a sketch of this configuration. The motor will be vibrated in each of the three orthogonal axes as shown in Figure 3. The control signal shall be the average of two accelerometers located on the fixture near each bracket/ fixture attach point. Two triaxial response accelerometers shall be attached to the motor near zero degrees at the aft end, and 180 degrees at the forward end, as shown in Figure 3. Accelerometers shall be oriented to the test axes as shown in Figure 3. Hard mount the control accelerometers to the vibration test fixture at the forward and aft attach points and parallel to the direction of excitation. Secure the accelerometer cables to the test fixture with tape. Use an oscilloscope to verify that the noise floor of the vibration control system on the control accelerometer is 0.2 g or less.

7.2 Attach Adapter Plates to the Aft Skirt Support Brackets

7.2.1 Attach the belly straps as shown in Figure 4b for the installation of the adapter plates. [✓]

CAUTION: The following step involves working with a suspended load. Keep feet and hands out from under the load unless the load is properly blocked up.

CAUTION: Exercise care not to entangle or tug on the motor grounding strap during the following lifting operations.

7.2.2 Lift the test item off the pallet and rotate the motor 180° so that the aft skirt attach bracket mounting holes face up. [✓]

7.2.3 Place the motor on the wood supports. [✓]

REMINDER: Be sure to put the custom shims in their correct positions and orientation before sliding bolts through the adapter plates.

CAUTION: When using grease, personnel shall wear Neoprene-Latex gloves. Contaminated materials shall be disposed of as hazardous waste.

7.2.4 Place the adapter plates on the BSM brackets and insert the bracket to adapter plate bolts (wet with HD-2 grease) through the brackets and adapter plate. [✓]

7.2.5 Place the appropriate nuts and washers on the bolts but DO NOT torque. [✓]

9-21-93

Due to misalignment of
Rjf 9-21-93 front adapter plate, positions C and D
MB 9-21-93 had to be de-torqued and re-torqued
RC 9-21-93 The same torque values were used.

7.2.6 Install adapter plate to vibration table fasteners through the adapter plates and secure with wing nuts. [✓]

7.2.7 Torque the EWB0420-8-31 bolts (10107-8-31 alternate) with NAS1587-8C washers and TLN1021CPD2-8 self-aligning nuts at "A", "B", and "D" positions (as marked on supports, 6 places) to 605 to 710 in-lbs (51 to 60 ft - lbs) above running torque. At the "C" position, torque the EWB0420-10-32 bolts (10107-10-32 alternate) with NAS1587-10C washers and TLN1023CD3-10 self-aligning nuts (2 places) to 1175 to 1380 in-lbs (98 to 115 ft -lbs) above running torque. Insure that bolt grip is free from the threaded area of nut and that threaded portion of bolt protrudes above nut; if not, use alternate length bolt. [✓]

A, B, D torque values: 650 in-lbs MSFC QA RC
C torque value: 105 ft-lbs MSFC QA RC

Torque wrench SN: Pos 'C' EMJ00359 Pos A, B, D T-267-62 (4 & 11)

CAUTION: Be careful not to disconnect the motor ground while lifting.

CAUTION: The following step involves working with a suspended load. Keep feet and hands out from under the load.

7.2.8 Lift motor off of the wood supports to waist height and rotate 180° so that the bracket mounts are face down. [✓]

7.2.9 Remove wing nuts from the adapter plate to vibration table fasteners. [✓]

7.3 Position the Test Item Over the Vibration Table Using the Overhead Crane. Align the Test Item With the Proper Holes in the Table. [✓]

7.4 Adapter Plate Attachment to the Vibration Table [✓]

The adapter plates shall be attached to the vibration table using the fasteners that are normally used by the vibration lab. The fasteners used are 1/2 inch diameter bolts. These bolts should be torqued to 65 foot-pounds.

Record torque value: 65 ft-lbs MSFC QA RC

Torque wrench SN: BTW - 2RCF

7.5 Disconnect the lifting straps from the motor and crane. [✓]

7.6 Connect vibration instrumentation as shown in Fig 3 [✓]

MB 09/21/93
RC 9-21-93
RJ 9-21-93

9-21-93

8.0 Thermal Conditioning Setup

General Information:

The BSM motor will be temperature conditioned for a minimum of 24 hours prior to vibration, and shall be maintained at temperature during vibration. The motor will be conditioned to 125 (+5, -0)°F or to 25 (+0, -5)°F.

NOTE: The MSFC TE should mark below which of the two qualification motors pertains to this procedure. The conditioning period starts after the average air temperature inside the conditioning chamber stabilizes at the required temperature. Should the motor be out of conditioning tolerances for greater than 30 minutes, it must be reconditioned for twice the time out of tolerance.

Motor #1 125 °F	Motor #2 ________ °F
Motor SN 1000738	Motor SN ________

8.1 Conditioning Chamber Setup for Radial Axis

8.1.1 Use the overhead crane to place the conditioning chamber over the motor. [✓]

8.1.2 Once the chamber is in place, attach the necessary hoses and instrumentation from the conditioning unit to the chamber. [✓]

8.1.3 Make sure the chamber thermocouple is in the correct position for measuring the air temperature around the motor. [✓]

8.1.4 Make sure the motor ground strap is secured. [✓]

8.1.5 Activate conditioning unit and monitor the temperature. The chamber is considered "at temperature" when the temperature has stabilized at the desired value. [✓]

Record time when chamber reached desired value: 16:52 09/21/93

MB

9-21-93

9.0 **Post Test Verification**

The procedure delineated in the above document has been satisfactorily completed and :

a. All sequences in the procedure have been completed (or deleted by approved deviation)

b. All Procedure changes have been recorded and approved.

Submitted Verified by: Mat Berill
Test Engineer

Date: 09/21/93

Motor Serial Number: 1000238

9-21-93

Appendix A

Test Procedure Deviation

Figure 1

TEST PROCEDURE DEVIATION

TEST ENGINEER:	QUALITY	TCP NO.:
		DATE
REQUIREMENTS ENGINEER:	OTHER:	
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 1

TEST PROCEDURE DEVIATION		TCP NO.:
TEST ENGINEER:	QUALITY	DATE
REQUIREMENTS ENGINEER:	OTHER:	SHEET OF
TITLE:		

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 2

DEVIATION LOG

PROCEDURE ________________ REVISION ________________

DEV NO.	PAGE	PARA STEP	REASON/REMARKS	P/T	DATE	
					ISSUED	SIGNED

Appendix B

Figures

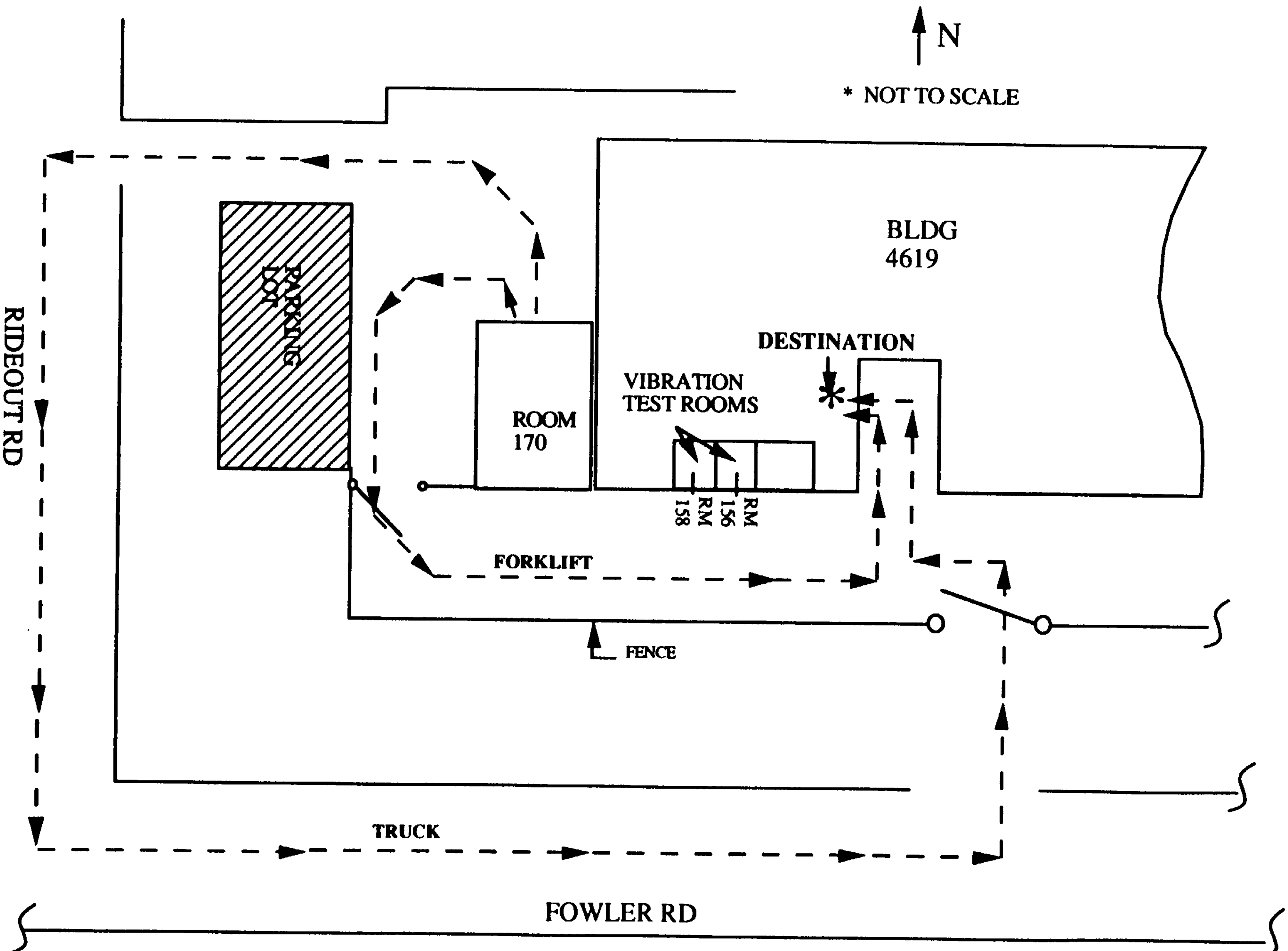


FIGURE 1. TRUCK ROUTE FROM PYRO TO VIBRATION

DRAWN BY:
K.MITCHELL/BP54
4/8/93

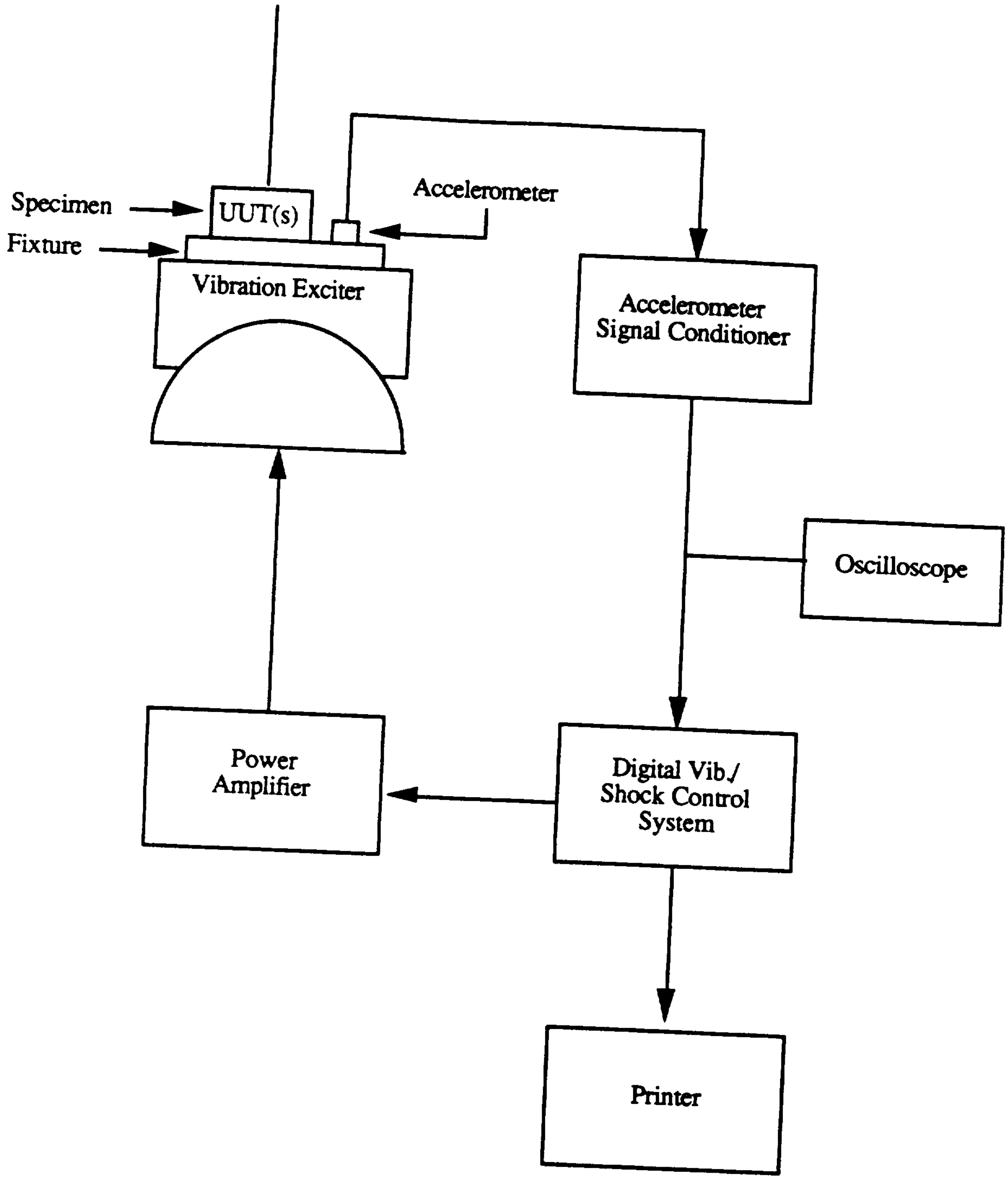
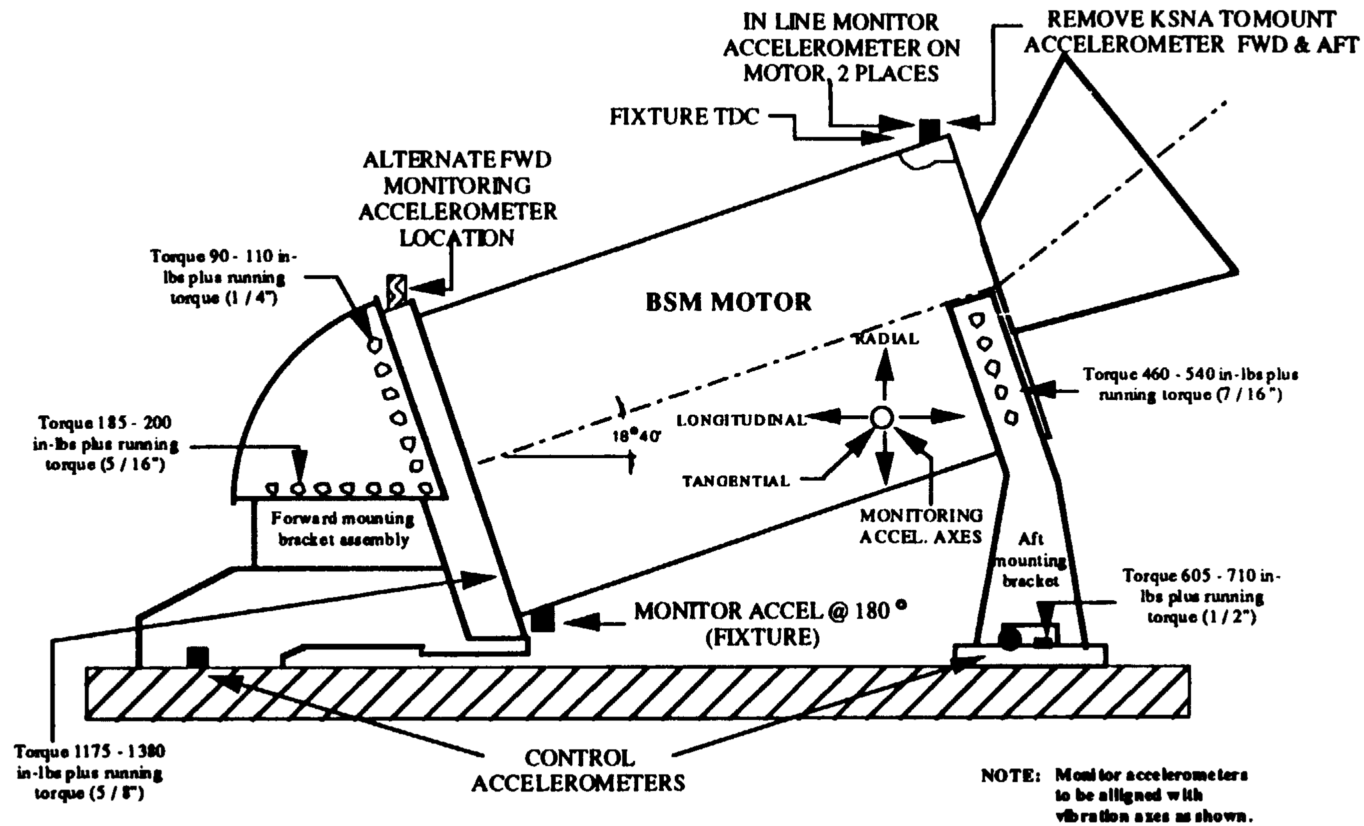


FIGURE 2. BLOCK DIAGRAM OF VIBRATION TEST SETUP

DRAWN BY:
K. MITCHELL/EP54
4/19/93



NOTE: If forward monitoring acceleromenter cannot be mounted to the bracket assembly at fixture 180° location, it may be mounted on the bracket at fixture TDC (forward).

FIGURE 3. VIBRATION TEST SETUP

DRAWN BY:
K.MITCHELL/EP54
4/14/93

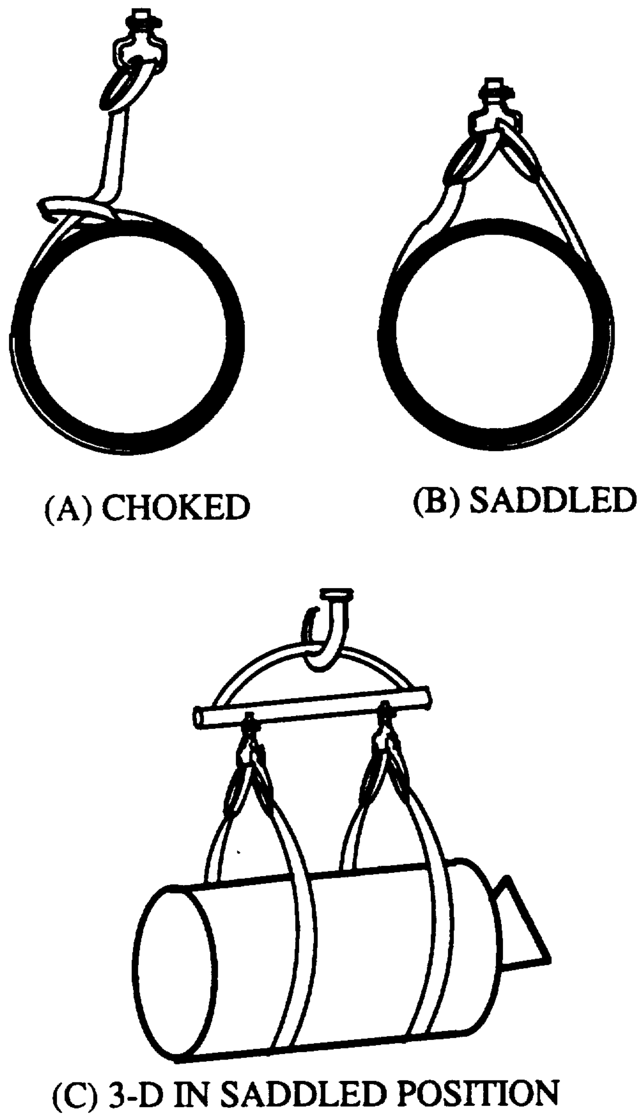


FIGURE 4. LIFTING STRAP ATTACHMENTS

DRAWN BY:
K. MITCHELL/EP54
3/8/93

Appendix C

Proof Test Inspection Sheet

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature: Booster Separation Motor

b. SN: RR-328 (Crane) (Motor SN 1000738)

2. Handling Procedure Number

BSM-TCP-EP54-001

3. Location of Lift (Fac. Bldg.)

a. Building: 4619 crane BB494 rm 156

b. Date of lift: 9-20-93

4. Weight to be Lifted (in lbs.)

a. Item: RC ~~500 lbs~~ 310 lbs

b. Hoisting Equipment ~20 lbs

c. Total: RC ~~500 lbs~~ 330 lbs

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ✓
2. Equipment tagged with appropriate max working loads ✓
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ✓
4. Assessment prior to critical lift complete per MSFC-STD-126E ✓

b. Operator's Certification Validation:

Crane Rocky Stephens Rigger ______ Flagman ______

Forklift ______ Driver ______ Personnel Hoist ______

c. Visual inspection shows no evidence of damage, excessive wear or abuse. OK

d. Dummy load lift of 500 lbs. completed and no discrepancies noted. ✓

6. For additional information, observations and remarks

______

______

______

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager [signature] Date 9/20/93

MSFC Safety Richard Y Flood Date 9/20/93

MSFC Quality Rick Clement Date 9/20/93

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Appendix A

Test Procedure Deviation

Figure 1

TEST PROCEDURE DEVIATION		TCP NO.: BSM-TCP-EP54-003
TEST ENGINEER: Mat Berill MB 9-22-93	QUALITY: Rick Clements RC 9-22-93	DATE: 09/22/93
REQUIREMENTS ENGINEER:	OTHER: Richard Leonard RL 9-22-93	SHEET 1 OF 2

TITLE: Radial Axis, Boost Vibration time Limit (motor 1000738)

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/TEMP.
1			Boost vibration time duration should be 120 sec as stated in BSM-TCP-EP54-003 step 6.2.3.1. Boost vibration test was only conducted for 60 sec. Conditioning equipment and instrumentation were re-connected. Chamber temp was resumed 24.5 minutes after chamber removal. Testing was resumed per NOTE: in section 8.0 in BSM-TCP-EP54-002. The final 60 secs. were finished after chamber resumed temp.	Temp
2			Lift off vibration time (Radial Axis) was short by 1 sec. Once the chamber resumed temperature (see Dev. 1 above) the test was resumed. (i.e. Lift off vibration was performed for one more second.) Time tolerance as stated in 4.2.1 has time tolerance of +10%, -0%	Temp

ORIGINATOR: Mat Berill	ORGANIZATION: EP12
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL: NO / SAFETY: Richard Leonard	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS: Yes

Figure 1

TEST PROCEDURE DEVIATION

TEST ENGINEER: Mat Bevill MB 09/22/93	QUALITY: Rick Clements RC 9-22-93	TCP NO.: BSM-TCP-EP54-005
REQUIREMENTS ENGINEER: —	OTHER: Richard Leonard RL 9-22-93	DATE: 09/22/93
		SHEET 2 OF

TITLE: FWD Bracket to motor attach fasteners loosened during Vibration

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/TEMP.
3			The fwd bracket to motor attach bolts were torqued per step 6.2.2.4 in BSM-TCP-EP54-001. (150 in-lbs.) After finishing ~~During~~ the radial axis boost vibration test (see dev. 1) ~~the~~ It was noticed that 4 fasteners were in but loose, 2 were completely out, and 2 were tight. Photographs were taken. Fasteners were re-torqued per 6.2.2.4 in BSM-TCP-EP54-001 (150 in-lbs with the same torque wrench). These torques were then verified with another torque wrench SN:BTW-2RCF, * RETORQUEING THE BOLTS PER STEP 6.2.2.4 DOES NOT INCREASE THE HAZARD LEVEL. HOWEVER, AS STATED ABOVE THE FACT THAT THEY CAME LOOSE DURING VIBRATION TESTING DID INCREASE THE HAZARD LEVEL. PRECAUTIONS WILL BE TAKEN TO AVOID THIS HAPPENING AGAIN.	T

ORIGINATOR: Mat Bevill		ORGANIZATION: EP12
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL: * NO	SAFETY: Richard W Leonard	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 1

TEST PROCEDURE DEVIATION		TCP NO.:
TEST ENGINEER:	QUALITY	DATE
REQUIREMENTS ENGINEER:	OTHER:	
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 2

DEVIATION LOG

PROCEDURE BSM-TCP-EP54-0?? REVISION

DEV NO.	PAGE	PARA STEP	REASON/REMARKS	P/T	DATE ISSUED	DATE SIGNED
1			Radial Axis, boost vibration time limit (should have been 120 sec, performed for 60 sec)	T	9-22-93	[illegible] 9-22-93
2			Lift off vibration time short by 1 sec	T	9-22-93	[illegible] 9-22-93
3			Fwd bracket to motor fasteners loosened during vibration (radial axis)	T	9-22-93	[illegible] 9-22-93

J-4

Appendix C

Proof Test Inspection Sheet

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature: Booster Separation Motor

b. SN: 1000738 (BSM)

2. Handling Procedure Number

BSM-TCP-EP54-001

3. Location of Lift (Fac. Bldg.)

a. Building: [redacted] 4619 Forklift

b. Date of lift: 09/21/93

4. Weight to be Lifted (in lbs.)

a. Item: 310

b. Hoisting Equipment: 20

c. Total: 330

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ✓
2. Equipment tagged with appropriate max working loads ✓
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ✓
4. Assessment prior to critical lift complete per MSFC-STD-126E ✓

b. Operator's Certification Validation:

Crane ______ Rigger ______ Flagman ______

Forklift PAT McCARRICK Driver ______ Personnel Hoist ______

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ✓

d. Dummy load lift of 500 lbs. completed and no discrepancies noted. ✓

6. For additional information, observations and remarks

______

______

______

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager [signature] Date 9/21/93

MSFC Safety [signature] Date 9-21-93

MSFC Quality [signature] Date 9-21-93

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature: Booster Separation Motor

b. SN: 1000738 (BSM)

2. Handling Procedure Number

BSM-TLP-EP54-001

3. Location of Lift (Fac. Bldg.)

a. Building: 4619 rm 158 crane BB 477

b. Date of lift: 09/21/93

4. Weight to be Lifted (in lbs.)

a. Item: 310

b. Hoisting Equipment 20

c. Total: 330

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ✓
2. Equipment tagged with appropriate max working loads ✓
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ✓
4. Assessment prior to critical lift complete per MSFC-STD-126E ✓

b. Operator's Certification Validation:

Crane Pat McCarrick Rigger ______ Flagman ______

Forklift ______ Driver ______ Personnel Hoist ______

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ✓

d. Dummy load lift of 500 lbs. completed and no discrepancies noted. ✓

6. For additional information, observations and remarks

______

______

______

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager [signature] Date 9/21/93

MSFC Safety [signature] Date 9-21-93

MSFC Quality [signature] Date 9-21-93

Lifting Equipment Inspection Sheet

1. **PCH Identification**

   a. Nomenclature:

   b. SN:

2. **Handling Procedure Number**

3. **Location of Lift (Fac. Bldg.)**

   a. Building: ____________

   b. Date of lift: ____________

4. **Weight to be Lifted (in lbs.)**

   a. Item: ____________

   b. Hoisting Equipment ____________

   c. Total: ____________

5. **Checklist**

   a. Assessment Prior to Critical Lift

      1. Maintenance records ____________
      2. Equipment tagged with appropriate max working loads ____________
      3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
      4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

   b. Operator's Certification Validation:

      Crane ____________ Rigger ____________ Flagman ____________

      Forklift ____________ Driver ____________ Personnel Hoist ____________

   c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

   d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. **For additional information, observations and remarks**

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________________ Date ____________

MSFC Safety ____________________ Date ____________

MSFC Quality ____________________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: __________

b. Date of lift: __________

4. Weight to be Lifted (in lbs.)

a. Item: __________

b. Hoisting Equipment __________

c. Total: __________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records __________
2. Equipment tagged with appropriate max working loads __________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured __________
4. Assessment prior to critical lift complete per MSFC-STD-126E __________

b. Operator's Certification Validation:

Crane __________ Rigger __________ Flagman __________

Forklift __________ Driver __________ Personnel Hoist __________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. __________

d. Dummy load lift of ______ lbs. completed and no discrepancies noted. __________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ______________ Date __________

MSFC Safety ______________ Date __________

MSFC Quality ______________ Date __________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

<u>I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.</u>

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

A:\Z001A
Thursday October 14, 1993 09:02:32 pm

Temp. History for Vibration

Booster Separation Motor: SN: 1000738

Temperature: 125 deg. F (+5 deg., -0 deg.)

264*13:36:19
002 72.5 F 003 72.5 F

264*13:38:19
002 72.6 F 003 72.6 F

264*13:40:19
002-****.* F 003-****.* F

264*13:42:19
002 71.4 F 003-****.* F

264*13:44:19
002 72.8 F 003 72.8 F

264*13:46:19
002 72.8 F 003 72.8 F

264*13:48:19
002 72.8 F 003 72.8 F

264*13:50:19
002 72.8 F 003 72.8 F

264*13:52:19
002 72.8 F 003 72.9 F

264*13:54:19
002 72.8 F 003 72.8 F

264*13:56:19
002 72.8 F 003 72.9 F

264*13:58:19
002 72.8 F 003 72.9 F

264*14:00:19
002 72.8 F 003 72.8 F

264*14:02:19
002 72.8 F 003 72.8 F

264*14:04:19
002 72.8 F 003 72.8 F

264*14:06:19
002 72.8 F 003 72.9 F

264*14:08:19
002 72.8 F 003 72.9 F

264*14:10:19

002 72.8 F 003 72.8 F

264*14:12:19
002 72.7 F 003 72.8 F

264*14:14:19
002 72.8 F 003 72.8 F

264*14:16:19
002 72.8 F 003 72.8 F

264*14:18:19
002 72.8 F 003 72.8 F

264*14:20:19
002 72.8 F 003 72.8 F

264*14:22:19
002 72.7 F 003 72.7 F

264*14:24:19
002 72.7 F 003 72.8 F

264*14:26:19
002 72.8 F 003 72.8 F

264*14:28:19
002 72.7 F 003 72.8 F

264*14:30:19
002 72.4 F 003 72.8 F

264*14:32:19
002 72.0 F 003 71.4 F

264*14:34:19
002 71.1 F 003 70.3 F

264*14:36:19
002 71.8 F 003 72.5 F

264*14:38:19
002 73.6 F 003 75.4 F

264*14:40:19
002 75.1 F 003 77.4 F

264*14:42:19
002 76.8 F 003 79.3 F

264*14:44:19
002 77.8 F 003 80.5 F

264 13:51:52
002 78.5 F 003 81.2 F

264 13:53:52

002 79.2 F 003 81.7 F

264 13:55:52
002 80.6 F 003 83.6 F

264 13:57:52
002 82.1 F 003 85.3 F

264 13:59:52
002 84.0 F 003 87.8 F

264 14:01:52
002 85.6 F 003 88.8 F

264 14:03:52
002 86.2 F 003 89.8 F

264 14:05:52
002 87.1 F 003 90.5 F

264 14:07:52
002 87.3 F 003 90.9 F

264 14:09:52
002 88.0 F 003 91.5 F

264 14:11:52
002 88.2 F 003 91.7 F

264 14:13:52
002 88.6 F 003 92.2 F

264 14:15:52
002 89.1 F 003 92.5 F

264 14:17:52
002 89.3 F 003 92.6 F

264 14:19:52
002 89.8 F 003 93.0 F

264 14:21:52
002 89.8 F 003 92.8 F

264 14:23:52
002 89.9 F 003 92.9 F

264 14:25:52
002 90.0 F 003 93.0 F

264 14:27:52
002 90.2 F 003 93.0 F

264 14:29:52
002 90.5 F 003 93.6 F

264 14:31:52

002 91.2 F 003 94.4 F

264 14:33:52
002 91.6 F 003 95.0 F

264 14:35:52
002 91.9 F 003 95.3 F

264 14:37:52
002 92.4 F 003 95.5 F

264 14:39:52
002 92.6 F 003 95.8 F

264 14:41:52
002 92.7 F 003 96.2 F

264 14:43:52
002 93.8 F 003 97.1 F

264 14:45:52
002 94.3 F 003 97.5 F

264 14:47:52
002 94.7 F 003 97.9 F

264 14:49:52
002 94.7 F 003 98.0 F

264 14:51:52
002 94.7 F 003 97.8 F

264 14:53:52
002 94.9 F 003 97.9 F

264 14:55:52
002 95.2 F 003 98.4 F

264 14:57:52
002 95.5 F 003 98.8 F

264 14:59:52
002 95.8 F 003 99.0 F

264 15:01:52
002 95.9 F 003 99.0 F

264 15:03:52
002 96.0 F 003 99.1 F

264 15:05:52
002 96.3 F 003 99.5 F

264 15:07:52
002 96.4 F 003 99.4 F

264 15:09:52

002 96.3 F 003 99.4 F

264 15:11:52
002 96.5 F 003 99.5 F

264 15:13:52
002 96.8 F 003 99.7 F

264 15:15:52
002 96.8 F 003 99.7 F

264 15:17:52
002 97.4 F 003 100.3 F

264 15:19:52
002 98.7 F 003 101.9 F

264 15:21:52
002 101.1 F 003 106.1 F

264 15:23:52
002 103.6 F 003 108.8 F

264 15:25:52
002 104.3 F 003 108.8 F

264 15:27:52
002 104.7 F 003 108.7 F

264 15:29:52
002 104.6 F 003 108.7 F

264 15:31:52
002 105.1 F 003 109.0 F

264 15:33:52
002 105.4 F 003 109.0 F

264 15:35:52
002 105.4 F 003 109.1 F

264 15:37:52
002 105.7 F 003 109.5 F

264 15:39:52
002 108.4 F 003 112.8 F

264 15:41:52
002 109.3 F 003 113.9 F

264 15:43:52
002 110.1 F 003 114.8 F

264 15:45:52
002 112.6 F 003 117.3 F

264 15:47:52

002 114.4 F 003 119.0 F

264 15:49:52
002 114.5 F 003 119.7 F

264 15:51:52
002 115.3 F 003 120.2 F

264 15:53:52
002 116.3 F 003 120.6 F

264 15:55:52
002 116.6 F 003 121.0 F

264 15:57:52
002 116.8 F 003 121.1 F

264 15:59:52
002 117.7 F 003 121.7 F

264 16:01:52
002 119.1 F 003 123.2 F

264 16:03:52
002 119.9 F 003 123.6 F

264 16:05:52
002 120.5 F 003 124.5 F

264 16:07:52
002 120.6 F 003 124.7 F

264 16:09:52
002 121.4 F 003 125.2 F

264 16:11:52
002 121.5 F 003 125.5 F

264 16:13:52
002 122.0 F 003 125.5 F

264 16:15:52
002 122.4 F 003 125.5 F

264 16:17:52
002 122.6 F 003 126.0 F

264 16:19:52
002 122.9 F 003 126.1 F

264 16:21:52
002 123.3 F 003 126.1 F

264 16:23:52
002 123.4 F 003 126.2 F

264 16:25:52

002 123.6 F 003 126.3 F

264 16:27:52
002 123.5 F 003 126.4 F

264 16:29:52
002 123.9 F 003 126.5 F

264 16:31:52
002 124.2 F 003 126.6 F

264 16:33:52
002 124.3 F 003 126.9 F

264 16:35:52
002 124.3 F 003 126.9 F

264 16:37:52
002 124.1 F 003 126.5 F

264 16:39:52
002 124.0 F 003 126.1 F

264 16:41:52
002 124.2 F 003 126.3 F

264 16:43:52
002 124.2 F 003 126.1 F

264 16:45:52
002 124.4 F 003 126.5 F

264 16:47:52
002 124.7 F 003 126.9 F

264 16:49:52
002 125.0 F 003 127.0 F

264 16:51:52
002 125.1 F 003 126.8 F

264 16:53:52
002 125.2 F 003 127.2 F

264 16:55:52
002 125.2 F 003 127.1 F

264 16:57:52
002 125.3 F 003 127.0 F

264 16:59:52
002 125.6 F 003 127.3 F

264 17:01:52
002 125.7 F 003 127.5 F

264 17:03:52

002 125.6 F 003 127.4 F

264 17:05:52
002 125.8 F 003 127.6 F

264 17:07:52
002 125.6 F 003 127.6 F

264 17:09:52
002 126.0 F 003 127.6 F

264 17:11:52
002 126.2 F 003 127.8 F

264 17:13:52
002 126.2 F 003 127.8 F

264 17:15:52
002 126.2 F 003 127.7 F

264 17:17:52
002 126.1 F 003 127.6 F

264 17:19:52
002 126.0 F 003 127.3 F

264 17:21:52
002 126.0 F 003 127.3 F

264 17:23:52
002 125.9 F 003 127.4 F

264 17:25:52
002 126.1 F 003 127.6 F

264 17:27:52
002 126.2 F 003 127.8 F

264 17:29:52
002 126.2 F 003 127.6 F

264 17:31:52
002 126.4 F 003 127.4 F

264 17:33:52
002 126.3 F 003 127.4 F

264 17:35:52
002 126.2 F 003 127.5 F

264 17:37:52
002 126.5 F 003 127.7 F

264 17:39:52
002 126.5 F 003 127.5 F

264 17:41:52

002 126.5 F 003 127.9 F

264 17:43:52
002 126.5 F 003 127.8 F

264 17:45:52
002 126.7 F 003 127.8 F

264 17:47:52
002 126.8 F 003 127.9 F

264 17:49:52
002 126.7 F 003 127.8 F

264 17:51:52
002 126.6 F 003 127.5 F

264 17:53:52
002 126.4 F 003 127.5 F

264 17:55:52
002 126.4 F 003 127.4 F

264 17:57:52
002 126.4 F 003 127.4 F

264 17:59:52
002 126.6 F 003 127.5 F

264 18:01:52
002 126.4 F 003 127.5 F

264 18:03:52
002 126.6 F 003 127.6 F

264 18:05:52
002 126.8 F 003 127.8 F

264 18:07:52
002 126.6 F 003 127.6 F

264 18:09:52
002 126.9 F 003 127.7 F

264 18:11:52
002 126.7 F 003 127.6 F

264 18:13:52
002 126.4 F 003 127.4 F

264 18:15:52
002 126.6 F 003 127.2 F

264 18:17:52
002 126.6 F 003 127.4 F

264 18:19:52

002 126.5 F 003 127.4 F

264 18:21:52
002 126.6 F 003 127.3 F

264 18:23:52
002 126.6 F 003 127.6 F

264 18:25:52
002 126.8 F 003 127.6 F

264 18:27:52
002 126.8 F 003 127.7 F

264 18:29:52
002 126.8 F 003 127.5 F

264 18:31:52
002 126.6 F 003 127.4 F

264 18:33:52
002 126.8 F 003 127.4 F

264 18:35:52
002 126.8 F 003 127.6 F

264 18:37:52
002 126.9 F 003 127.7 F

264 18:39:52
002 127.0 F 003 127.8 F

264 18:41:52
002 127.0 F 003 127.8 F

264 18:43:52
002 127.0 F 003 127.9 F

264 18:45:52
002 127.0 F 003 127.8 F

264 18:47:52
002 127.0 F 003 127.8 F

264 18:49:52
002 127.2 F 003 127.8 F

264 18:51:52
002 127.2 F 003 127.9 F

264 18:53:52
002 126.9 F 003 127.8 F

264 18:55:52
002 127.0 F 003 127.8 F

264 18:57:52

002 127.1 F 003 127.7 F

264 18:59:52
002 127.0 F 003 127.8 F

264 19:01:52
002 127.2 F 003 127.9 F

264 19:03:52
002 127.2 F 003 127.8 F

264 19:05:52
002 127.2 F 003 127.9 F

264 19:07:52
002 127.2 F 003 127.8 F

264 19:09:52
002 127.4 F 003 127.9 F

264 19:11:52
002 127.2 F 003 127.8 F

264 19:13:52
002 127.2 F 003 127.9 F

264 19:15:52
002 127.2 F 003 128.0 F

264 19:17:52
002 127.3 F 003 128.0 F

264 19:19:52
002 127.4 F 003 127.9 F

264 19:21:52
002 127.4 F 003 127.8 F

264 19:23:52
002 127.4 F 003 128.1 F

264 19:25:52
002 127.4 F 003 127.9 F

264 19:27:52
002 127.5 F 003 128.0 F

264 19:29:52
002 127.5 F 003 128.0 F

264 19:31:52
002 127.4 F 003 127.8 F

264 19:33:52
002 127.5 F 003 127.9 F

264 19:35:52

002 127.4 F 003 127.9 F

264 19:37:52
002 127.4 F 003 127.9 F

264 19:39:52
002 127.5 F 003 128.1 F

264 19:41:52
002 127.4 F 003 128.0 F

264 19:43:52
002 127.4 F 003 127.8 F

264 19:45:52
002 127.5 F 003 128.1 F

264 19:47:52
002 127.5 F 003 128.0 F

264 19:49:52
002 127.5 F 003 128.0 F

264 19:51:52
002 127.3 F 003 127.7 F

264 19:53:52
002 127.5 F 003 127.9 F

264 19:55:52
002 127.5 F 003 128.0 F

264 19:57:52
002 127.4 F 003 127.8 F

264 19:59:52
002 127.5 F 003 127.9 F

264 20:01:52
002 127.5 F 003 128.0 F

264 20:03:52
002 127.6 F 003 128.1 F

264 20:05:52
002 127.6 F 003 128.0 F

264 20:07:52
002 127.7 F 003 128.0 F

264 20:09:52
002 127.6 F 003 128.0 F

264 20:11:52
002 127.4 F 003 127.9 F

264 20:13:52

002 127.3 F 003 127.8 F

264 20:15:52
002 127.3 F 003 127.7 F

264 20:17:52
002 127.4 F 003 127.8 F

264 20:19:52
002 127.5 F 003 127.8 F

264 20:21:52
002 127.4 F 003 127.7 F

264 20:23:52
002 127.5 F 003 127.9 F

264 20:25:52
002 127.5 F 003 128.0 F

264 20:27:52
002 127.5 F 003 127.8 F

264 20:29:52
002 127.7 F 003 128.0 F

264 20:31:52
002 127.6 F 003 128.0 F

264 20:33:52
002 127.7 F 003 128.0 F

264 20:35:52
002 127.7 F 003 128.0 F

264 20:37:52
002 127.7 F 003 128.0 F

264 20:39:52
002 127.7 F 003 128.1 F

264 20:41:52
002 127.7 F 003 128.1 F

264 20:43:52
002 127.8 F 003 128.1 F

264 20:45:52
002 127.8 F 003 128.0 F

264 20:47:52
002 127.5 F 003 127.9 F

264 20:49:52
002 127.5 F 003 127.6 F

264 20:51:52

002 127.6 F 003 127.9 F

264 20:53:52
002 127.5 F 003 127.7 F

264 20:55:52
002 127.5 F 003 127.9 F

264 20:57:52
002 127.5 F 003 127.8 F

264 20:59:52
002 127.5 F 003 127.6 F

264 21:01:52
002 127.6 F 003 127.8 F

264 21:03:52
002 127.5 F 003 127.7 F

264 21:05:52
002 127.6 F 003 127.8 F

264 21:07:52
002 127.7 F 003 128.0 F

264 21:09:52
002 127.7 F 003 128.0 F

264 21:11:52
002 127.6 F 003 127.8 F

264 21:13:52
002 127.7 F 003 128.0 F

264 21:15:52
002 127.5 F 003 127.7 F

264 21:17:52
002 127.4 F 003 127.6 F

264 21:19:52
002 127.4 F 003 127.7 F

264 21:21:52
002 127.4 F 003 127.7 F

264 21:23:52
002 127.5 F 003 127.7 F

264 21:25:52
002 127.3 F 003 127.5 F

264 21:27:52
002 127.5 F 003 127.6 F

264 21:29:52

002 127.5 F 003 127.7 F

264 21:31:52
002 127.4 F 003 127.5 F

264 21:33:52
002 127.4 F 003 127.5 F

264 21:35:52
002 127.5 F 003 127.6 F

264 21:37:52
002 127.5 F 003 127.8 F

264 21:39:52
002 127.5 F 003 127.7 F

264 21:41:52
002 127.5 F 003 127.6 F

264 21:43:52
002 127.5 F 003 127.7 F

264 21:45:52
002 127.6 F 003 127.7 F

264 21:47:52
002 127.6 F 003 127.7 F

264 21:49:52
002 127.6 F 003 127.7 F

264 21:51:52
002 127.6 F 003 127.8 F

264 21:53:52
002 127.6 F 003 127.8 F

264 21:55:52
002 127.6 F 003 127.6 F

264 21:57:52
002 127.6 F 003 127.8 F

264 21:59:52
002 127.7 F 003 127.8 F

264 22:01:52
002 127.6 F 003 127.7 F

264 22:03:52
002 127.5 F 003 127.6 F

264 22:05:52
002 127.5 F 003 127.6 F

264 22:07:52

002 127.5 F 003 127.5 F

264 22:09:52
002 127.6 F 003 127.7 F

264 22:11:52
002 127.5 F 003 127.7 F

264 22:13:52
002 127.6 F 003 127.6 F

264 22:15:52
002 127.6 F 003 127.6 F

264 22:17:52
002 127.6 F 003 127.6 F

264 22:19:52
002 127.6 F 003 127.8 F

264 22:21:52
002 127.6 F 003 127.7 F

264 22:23:52
002 127.7 F 003 127.8 F

264 22:25:52
002 127.6 F 003 127.6 F

264 22:27:52
002 127.7 F 003 127.8 F

264 22:29:52
002 127.7 F 003 127.7 F

264 22:31:52
002 127.6 F 003 127.5 F

264 22:33:52
002 127.5 F 003 127.6 F

264 22:35:52
002 127.5 F 003 127.5 F

264 22:37:52
002 127.6 F 003 127.5 F

264 22:39:52
002 127.5 F 003 127.6 F

264 22:41:52
002 127.6 F 003 127.6 F

264 22:43:52
002 127.5 F 003 127.5 F

264 22:45:52

002 127.6 F 003 127.7 F

264 22:47:52
002 127.5 F 003 127.5 F

264 22:49:52
002 127.5 F 003 127.4 F

264 22:51:52
002 127.6 F 003 127.7 F

264 22:53:52
002 127.6 F 003 127.7 F

264 22:55:52
002 127.6 F 003 127.6 F

264 22:57:52
002 127.7 F 003 127.7 F

264 22:59:52
002 127.6 F 003 127.6 F

264 23:01:52
002 127.5 F 003 127.5 F

264 23:03:52
002 127.7 F 003 127.7 F

264 23:05:52
002 127.6 F 003 127.7 F

264 23:07:52
002 127.7 F 003 127.8 F

264 23:09:52
002 127.7 F 003 127.6 F

264 23:11:52
002 127.6 F 003 127.6 F

264 23:13:52
002 127.7 F 003 127.9 F

264 23:15:52
002 127.7 F 003 127.7 F

264 23:17:52
002 127.7 F 003 127.7 F

264 23:19:52
002 127.7 F 003 127.7 F

264 23:21:52
002 127.7 F 003 127.7 F

264 23:23:52

002 127.7 F 003 127.7 F

264 23:25:52
002 127.7 F 003 127.6 F

264 23:27:52
002 127.6 F 003 127.6 F

264 23:29:52
002 127.6 F 003 127.7 F

264 23:31:52
002 127.5 F 003 127.5 F

264 23:33:52
002 127.5 F 003 127.5 F

264 23:35:52
002 127.6 F 003 127.5 F

264 23:37:52
002 127.5 F 003 127.5 F

264 23:39:52
002 127.6 F 003 127.6 F

264 23:41:52
002 127.6 F 003 127.7 F

264 23:43:52
002 127.7 F 003 127.6 F

264 23:45:52
002 127.6 F 003 127.6 F

264 23:47:52
002 127.6 F 003 127.6 F

264 23:49:52
002 127.7 F 003 127.7 F

264 23:51:52
002 127.6 F 003 127.6 F

264 23:53:52
002 127.6 F 003 127.5 F

264 23:55:52
002 127.6 F 003 127.6 F

264 23:57:52
002 127.7 F 003 127.6 F

264 23:59:52
002 127.7 F 003 127.5 F

265 00:01:52

002 127.6 F 003 127.6 F

265 00:03:52
002 127.7 F 003 127.6 F

265 00:05:52
002 127.7 F 003 127.7 F

265 00:07:52
002 127.7 F 003 127.6 F

265 00:09:52
002 127.7 F 003 127.7 F

265 00:11:52
002 127.8 F 003 127.7 F

265 00:13:52
002 127.9 F 003 127.8 F

265 00:15:52
002 127.8 F 003 127.7 F

265 00:17:52
002 127.8 F 003 127.7 F

265 00:19:52
002 127.7 F 003 127.7 F

265 00:21:52
002 127.7 F 003 127.6 F

265 00:23:52
002 127.7 F 003 127.6 F

265 00:25:52
002 127.8 F 003 127.8 F

265 00:27:52
002 127.8 F 003 127.8 F

265 00:29:52
002 127.8 F 003 127.7 F

265 00:31:52
002 127.9 F 003 127.8 F

265 00:33:52
002 127.7 F 003 127.6 F

265 00:35:52
002 127.7 F 003 127.7 F

265 00:37:52
002 127.7 F 003 127.7 F

265 00:39:52

002 127.7 F 003 127.5 F

265 00:41:52
002 127.7 F 003 127.6 F

265 00:43:52
002 127.7 F 003 127.6 F

265 00:45:52
002 127.7 F 003 127.5 F

265 00:47:52
002 127.7 F 003 127.7 F

265 00:49:52
002 127.5 F 003 127.4 F

265 00:51:52
002 127.6 F 003 127.5 F

265 00:53:52
002 127.6 F 003 127.5 F

265 00:55:52
002 127.6 F 003 127.6 F

265 00:57:52
002 127.7 F 003 127.6 F

265 00:59:52
002 127.7 F 003 127.7 F

265 01:01:52
002 127.6 F 003 127.6 F

265 01:03:52
002 127.7 F 003 127.4 F

265 01:05:52
002 127.6 F 003 127.5 F

265 01:07:52
002 127.6 F 003 127.6 F

265 01:09:52
002 127.7 F 003 127.4 F

265 01:11:52
002 127.7 F 003 127.7 F

265 01:13:52
002 127.7 F 003 127.6 F

265 01:15:52
002 127.6 F 003 127.5 F

265 01:17:52

002 127.7 F 003 127.6 F

265 01:19:52
002 127.7 F 003 127.5 F

265 01:21:52
002 127.7 F 003 127.5 F

265 01:23:52
002 127.6 F 003 127.5 F

265 01:25:52
002 127.7 F 003 127.6 F

265 01:27:52
002 127.7 F 003 127.5 F

265 01:29:52
002 127.7 F 003 127.6 F

265 01:31:52
002 127.8 F 003 127.8 F

265 01:33:52
002 127.7 F 003 127.5 F

265 01:35:52
002 127.7 F 003 127.6 F

265 01:37:52
002 127.8 F 003 127.7 F

265 01:39:52
002 127.6 F 003 127.6 F

265 01:41:52
002 127.8 F 003 127.6 F

265 01:43:52
002 127.8 F 003 127.7 F

265 01:45:52
002 127.8 F 003 127.6 F

265 01:47:52
002 127.7 F 003 127.5 F

265 01:49:52
002 127.8 F 003 127.7 F

265 01:51:52
002 127.8 F 003 127.8 F

265 01:53:52
002 127.8 F 003 127.6 F

265 01:55:52

002 127.6 F 003 127.5 F

265 01:57:52
002 127.7 F 003 127.6 F

265 01:59:52
002 127.6 F 003 127.6 F

265 02:01:52
002 127.5 F 003 127.2 F

265 02:03:52
002 127.6 F 003 127.4 F

265 02:05:52
002 127.5 F 003 127.3 F

265 02:07:52
002 127.5 F 003 127.2 F

265 02:09:52
002 127.6 F 003 127.4 F

265 02:11:52
002 127.5 F 003 127.4 F

265 02:13:52
002 127.6 F 003 127.4 F

265 02:15:52
002 127.6 F 003 127.5 F

265 02:17:52
002 127.5 F 003 127.3 F

265 02:19:52
002 127.6 F 003 127.5 F

265 02:21:52
002 127.6 F 003 127.4 F

265 02:23:52
002 127.6 F 003 127.6 F

265 02:25:52
002 127.6 F 003 127.5 F

265 02:27:52
002 127.5 F 003 127.4 F

265 02:29:52
002 127.6 F 003 127.4 F

265 02:31:52
002 127.6 F 003 127.4 F

265 02:33:52

002 127.6 F 003 127.3 F

265 02:35:52
002 127.6 F 003 127.6 F

265 02:37:52
002 127.6 F 003 127.5 F

265 02:39:52
002 127.6 F 003 127.4 F

265 02:41:52
002 127.5 F 003 127.4 F

265 02:43:52
002 127.6 F 003 127.5 F

265 02:45:52
002 127.6 F 003 127.3 F

265 02:47:52
002 127.6 F 003 127.5 F

265 02:49:52
002 127.6 F 003 127.4 F

265 02:51:52
002 127.6 F 003 127.5 F

265 02:53:52
002 127.6 F 003 127.5 F

265 02:55:52
002 127.6 F 003 127.4 F

265 02:57:52
002 127.6 F 003 127.3 F

265 02:59:52
002 127.6 F 003 127.3 F

265 03:01:52
002 127.6 F 003 127.5 F

265 03:03:52
002 127.6 F 003 127.4 F

265 03:05:52
002 127.7 F 003 127.6 F

265 03:07:52
002 127.6 F 003 127.4 F

265 03:09:52
002 127.6 F 003 127.2 F

265 03:11:52

002 127.6 F 003 127.4 F

265 03:13:52
002 127.7 F 003 127.5 F

265 03:15:52
002 127.6 F 003 127.4 F

265 03:17:52
002 127.7 F 003 127.5 F

265 03:19:52
002 127.6 F 003 127.3 F

265 03:21:52
002 127.6 F 003 127.4 F

265 03:23:52
002 127.6 F 003 127.2 F

265 03:25:52
002 127.6 F 003 127.4 F

265 03:27:52
002 127.7 F 003 127.5 F

265 03:29:52
002 127.6 F 003 127.5 F

265 03:31:52
002 127.7 F 003 127.5 F

265 03:33:52
002 127.6 F 003 127.4 F

265 03:35:52
002 127.7 F 003 127.6 F

265 03:37:52
002 127.7 F 003 127.5 F

265 03:39:52
002 127.7 F 003 127.4 F

265 03:41:52
002 127.6 F 003 127.4 F

265 03:43:52
002 127.7 F 003 127.4 F

265 03:45:52
002 127.7 F 003 127.5 F

265 03:47:52
002 127.7 F 003 127.5 F

265 03:49:52

002 127.7 F 003 127.6 F

265 03:51:52
002 127.7 F 003 127.5 F

265 03:53:52
002 127.8 F 003 127.6 F

265 03:55:52
002 127.6 F 003 127.3 F

265 03:57:52
002 127.7 F 003 127.4 F

265 03:59:52
002 127.7 F 003 127.5 F

265 04:01:52
002 127.7 F 003 127.3 F

265 04:03:52
002 127.7 F 003 127.4 F

265 04:05:52
002 127.7 F 003 127.4 F

265 04:07:52
002 127.7 F 003 127.3 F

265 04:09:52
002 127.7 F 003 127.5 F

265 04:11:52
002 127.7 F 003 127.7 F

265 04:13:52
002 127.7 F 003 127.4 F

265 04:15:52
002 127.7 F 003 127.5 F

265 04:17:52
002 127.6 F 003 127.4 F

265 04:19:52
002 127.7 F 003 127.4 F

265 04:21:52
002 127.7 F 003 127.4 F

265 04:23:52
002 127.7 F 003 127.4 F

265 04:25:52
002 127.7 F 003 127.4 F

265 04:27:52

002 127.7 F 003 127.5 F

265 04:29:52
002 127.7 F 003 127.4 F

265 04:31:52
002 127.8 F 003 127.5 F

265 04:33:52
002 127.8 F 003 127.5 F

265 04:35:52
002 127.7 F 003 127.4 F

265 04:37:52
002 127.7 F 003 127.5 F

265 04:39:52
002 127.7 F 003 127.5 F

265 04:41:52
002 127.8 F 003 127.4 F

265 04:43:52
002 127.7 F 003 127.4 F

265 04:45:52
002 127.7 F 003 127.4 F

265 04:47:52
002 127.7 F 003 127.5 F

265 04:49:52
002 127.7 F 003 127.2 F

265 04:51:52
002 127.8 F 003 127.6 F

265 04:53:52
002 127.7 F 003 127.5 F

265 04:55:52
002 127.7 F 003 127.5 F

265 04:57:52
002 127.7 F 003 127.4 F

265 04:59:52
002 127.6 F 003 127.5 F

265 05:01:52
002 127.5 F 003 127.3 F

265 05:03:52
002 127.6 F 003 127.2 F

265 05:05:52

002 127.5 F 003 127.2 F

265 05:07:52
002 127.5 F 003 127.2 F

265 05:09:52
002 127.5 F 003 127.1 F

265 05:11:52
002 127.5 F 003 127.2 F

265 05:13:52
002 127.5 F 003 127.1 F

265 05:15:52
002 127.6 F 003 127.4 F

265 05:17:52
002 127.5 F 003 127.1 F

265 05:19:52
002 127.6 F 003 127.2 F

265 05:21:52
002 127.6 F 003 127.2 F

265 05:23:52
002 127.6 F 003 127.3 F

265 05:25:52
002 127.5 F 003 127.2 F

265 05:27:52
002 127.6 F 003 127.2 F

265 05:29:52
002 127.5 F 003 127.2 F

265 05:31:52
002 127.5 F 003 127.3 F

265 05:33:52
002 127.6 F 003 127.2 F

265 05:35:52
002 127.5 F 003 127.2 F

265 05:37:52
002 127.5 F 003 127.2 F

265 05:39:52
002 127.6 F 003 127.4 F

265 05:41:52
002 127.5 F 003 127.1 F

265 05:43:52

A:\Z001A
Thursday October 14, 1993 08:41:36 pm

002 127.6 F 003 127.3 F

265 05:45:52
002 127.5 F 003 127.0 F

265 05:47:52
002 127.6 F 003 127.4 F

265 05:49:52
002 127.5 F 003 127.1 F

265 05:51:52
002 127.6 F 003 127.3 F

265 05:53:52
002 127.6 F 003 127.2 F

265 05:55:52
002 127.6 F 003 127.3 F

265 05:57:52
002 127.6 F 003 127.3 F

265 05:59:52
002 127.6 F 003 127.3 F

265 06:01:52
002 127.6 F 003 127.3 F

265 06:03:52
002 127.5 F 003 127.1 F

265 06:05:52
002 127.6 F 003 127.2 F

265 06:07:52
002 127.5 F 003 127.1 F

265 06:09:52
002 127.5 F 003 127.1 F

265 06:11:52
002 127.6 F 003 127.2 F

265 06:13:52
002 127.5 F 003 127.2 F

265 06:15:52
002 127.6 F 003 127.2 F

265 06:17:52
002 127.7 F 003 127.4 F

265 06:19:52
002 127.5 F 003 127.3 F

265 06:21:52

002 127.6 F 003 127.2 F

265 06:23:52
002 127.6 F 003 127.1 F

265 06:25:52
002 127.6 F 003 127.5 F

265 06:27:52
002 127.6 F 003 127.4 F

265 06:29:52
002 127.6 F 003 127.1 F

265 06:31:52
002 127.6 F 003 127.2 F

265 06:33:52
002 127.6 F 003 127.3 F

265 06:35:52
002 127.6 F 003 127.2 F

265 06:37:52
002 127.5 F 003 127.1 F

265 06:39:52
002 127.6 F 003 127.4 F

265 06:41:52
002 127.5 F 003 127.1 F

265 06:43:52
002 127.5 F 003 127.1 F

265 06:45:52
002 127.5 F 003 127.2 F

265 06:47:52
002 127.5 F 003 127.1 F

265 06:49:52
002 127.5 F 003 127.1 F

265 06:51:52
002 127.4 F 003 127.1 F

265 06:53:52
002 127.4 F 003 127.1 F

265 06:55:52
002 127.4 F 003 127.1 F

265 06:57:52
002 127.4 F 003 127.0 F

265 06:59:52

002 127.4 F 003 127.0 F

265 07:01:52
002 127.4 F 003 127.1 F

265 07:03:52
002 127.4 F 003 127.1 F

265 07:05:52
002 127.4 F 003 127.0 F

265 07:07:52
002 127.4 F 003 127.1 F

265 07:09:52
002 127.5 F 003 127.1 F

265 07:11:52
002 127.5 F 003 127.1 F

265 07:13:52
002 127.5 F 003 127.1 F

265 07:15:52
002 127.5 F 003 127.0 F

265 07:17:52
002 127.5 F 003 127.1 F

265 07:19:52
002 127.4 F 003 127.0 F

265 07:21:52
002 127.5 F 003 127.0 F

265 07:22:02
002 127.5 F 003 127.0 F

265 07:22:05
002 127.5 F 003 127.0 F

265 07:22:08
002 127.5 F 003 127.0 F

265 07:22:11
002 127.5 F 003 127.0 F

265 07:22:14
002 127.5 F 003 127.0 F

265 07:22:17
002 127.5 F 003 127.1 F

265 07:22:20
002 127.5 F 003 127.1 F

265 07:22:23

002 127.5 F 003 127.1 F

265 07:22:26
002 127.5 F 003 127.1 F

265 07:22:29
002 127.5 F 003 127.1 F

265 07:23:52
002 127.5 F 003 127.2 F

265 07:25:52
002 127.5 F 003 127.1 F

265 07:27:52
002 127.5 F 003 127.1 F

265 07:29:52
002 127.6 F 003 127.2 F

265 07:31:52
002 127.5 F 003 127.1 F

265 07:33:52
002 127.5 F 003 127.2 F

265 07:35:52
002 127.5 F 003 127.2 F

265 07:37:52
002 127.5 F 003 127.1 F

265 07:39:52
002 127.5 F 003 127.1 F

265 07:41:52
002 127.5 F 003 127.1 F

265 07:43:52
002 127.4 F 003 127.2 F

265 07:45:52
002 127.6 F 003 127.3 F

265 07:47:52
002 127.5 F 003 127.1 F

265 07:49:52
002 127.5 F 003 127.2 F

265 07:51:52
002 127.6 F 003 127.2 F

265 07:53:52
002 127.5 F 003 127.2 F

265 07:55:52

002 127.6 F 003 127.2 F

265 07:57:52
002 127.5 F 003 127.1 F

265 07:59:52
002 127.5 F 003 127.1 F

265 08:01:52
002 127.6 F 003 127.2 F

265 08:03:52
002 127.5 F 003 127.1 F

265 08:05:52
002 127.5 F 003 127.0 F

265 08:07:52
002 127.5 F 003 127.1 F

265 08:09:52
002 127.6 F 003 127.2 F

265 08:11:52
002 127.6 F 003 127.2 F

265 08:13:52
002 127.6 F 003 127.3 F

265 08:15:52
002 127.6 F 003 127.2 F

265 08:17:52
002 127.5 F 003 127.1 F

265 08:19:52
002 127.5 F 003 127.2 F

265 08:21:52
002 127.5 F 003 127.1 F

265 08:23:52
002 127.6 F 003 127.2 F

265 08:25:52
002 127.5 F 003 127.0 F

265 08:27:52
002 127.6 F 003 127.1 F

265 08:29:52
002 127.5 F 003 127.2 F

265 08:31:52
002 127.5 F 003 127.2 F

265 08:33:52

002 127.5 F 003 127.0 F

265 08:35:52
002 127.5 F 003 127.1 F

265 08:37:52
002 127.4 F 003 127.1 F

265 08:39:52
002 127.5 F 003 127.1 F

265 08:41:52
002 127.5 F 003 127.1 F

265 08:43:52
002 127.5 F 003 127.1 F

265 08:45:52
002 127.5 F 003 127.1 F

265 08:47:52
002 127.4 F 003 127.0 F

265 08:49:52
002 127.5 F 003 127.1 F

265 08:51:52
002 127.5 F 003 127.2 F

265 08:53:52
002 127.5 F 003 127.1 F

265 08:55:52
002 127.5 F 003 127.0 F

265 08:57:52
002 127.5 F 003 127.0 F

265 08:59:52
002 127.4 F 003 127.2 F

265 09:01:52
002 127.5 F 003 127.1 F

265 09:03:52
002 127.5 F 003 127.0 F

265 09:05:52
002 127.5 F 003 126.9 F

265 09:07:52
002 127.6 F 003 127.4 F

265 09:09:52
002 127.5 F 003 127.0 F

265 09:11:52

002 127.5 F 003 127.1 F

265 09:13:52
002 127.5 F 003 127.0 F

265 09:15:52
002 127.5 F 003 127.1 F

265 09:17:52
002 127.6 F 003 127.1 F

265 09:19:52
002 127.5 F 003 127.1 F

265 09:21:52
002 127.4 F 003 127.0 F

265 09:23:52
002 127.5 F 003 127.0 F

265 09:25:52
002 127.5 F 003 127.1 F

265 09:27:52
002 127.5 F 003 127.2 F

265 09:29:52
002 127.6 F 003 127.1 F

265 09:31:52
002 127.5 F 003 127.1 F

265 09:33:52
002 127.5 F 003 127.0 F

265 09:35:52
002 127.5 F 003 127.1 F

265 09:37:52
002 127.5 F 003 127.0 F

265 09:39:52
002 127.5 F 003 127.0 F

265 09:41:52
002 127.6 F 003 127.1 F

265 09:43:52
002 127.6 F 003 127.2 F

265 09:45:52
002 127.5 F 003 127.1 F

265 09:47:52
002 127.4 F 003 127.0 F

265 09:49:52

002 127.5 F 003 127.2 F

265 09:51:52
002 127.5 F 003 127.1 F

265 09:53:52
002 127.5 F 003 127.0 F

265 09:55:52
002 127.5 F 003 127.2 F

265 09:57:52
002 127.5 F 003 127.1 F

265 09:59:52
002 127.5 F 003 127.1 F

265 10:01:52
002 127.5 F 003 127.0 F

265 10:03:52
002 127.6 F 003 127.1 F

265 10:05:52
002 127.5 F 003 127.0 F

265 10:07:52
002 127.6 F 003 127.3 F

265 10:09:52
002 127.5 F 003 127.0 F

265 10:11:52
002 127.6 F 003 127.1 F

265 10:13:52
002 127.5 F 003 127.0 F

265 10:15:52
002 127.5 F 003 127.1 F

265 10:17:52
002 127.5 F 003 127.1 F

265 10:19:52
002 127.6 F 003 127.2 F

265 10:21:52
002 127.6 F 003 127.2 F

265 10:23:52
002 127.5 F 003 127.1 F

265 10:25:52
002 127.6 F 003 127.1 F

265 10:27:52

002 127.5 F 003 127.1 F

265 10:29:52
002 127.5 F 003 127.1 F

265 10:31:52
002 127.6 F 003 127.1 F

265 10:33:52
002 127.5 F 003 127.1 F

265 10:35:52
002 127.6 F 003 127.2 F

265 10:37:52
002 127.6 F 003 127.1 F

265 10:39:52
002 127.5 F 003 127.1 F

265 10:41:52
002 127.6 F 003 127.1 F

265 10:43:52
002 127.5 F 003 127.1 F

265 10:45:52
002 127.6 F 003 127.1 F

265 10:47:52
002 127.6 F 003 127.2 F

265 10:49:52
002 127.6 F 003 127.1 F

265 10:51:52
002 127.6 F 003 127.2 F

265 10:53:52
002 127.5 F 003 127.1 F

265 10:55:52
002 127.6 F 003 127.1 F

265 10:57:52
002 127.6 F 003 127.1 F

265 10:59:52
002 127.6 F 003 127.2 F

265 11:01:52
002 127.6 F 003 127.1 F

265 11:03:52
002 127.6 F 003 127.2 F

265 11:05:52

002 127.5 F 003 127.1 F

265 11:07:52
002 127.5 F 003 127.2 F

265 11:09:52
002 127.5 F 003 127.1 F

265 11:11:52
002 127.6 F 003 127.2 F

265 11:13:52
002 127.6 F 003 127.2 F

265 11:15:52
002 127.5 F 003 127.1 F

265 11:17:52
002 127.6 F 003 127.1 F

265 11:19:52
002 127.6 F 003 127.2 F

265 11:21:52
002 127.5 F 003 127.0 F

265 11:23:52
002 127.6 F 003 127.2 F

265 11:25:52
002 127.6 F 003 127.1 F

265 11:27:52
002 127.5 F 003 127.0 F

265 11:29:52
002 127.6 F 003 127.2 F

265 11:31:52
002 127.6 F 003 127.2 F

265 11:33:52
002 127.6 F 003 127.1 F

265 11:35:52
002 127.6 F 003 127.3 F

265 11:37:52
002 127.6 F 003 127.3 F

265 11:39:52
002 127.6 F 003 127.1 F

265 11:41:52
002 127.6 F 003 127.0 F

265 11:43:52

002 127.6 F 003 127.2 F

265 11:45:52
002 127.5 F 003 127.1 F

265 11:47:52
002 127.6 F 003 127.2 F

265 11:49:52
002 127.6 F 003 127.1 F

265 11:51:52
002 127.6 F 003 127.1 F

265 11:53:52
002 127.6 F 003 127.3 F

265 11:55:52
002 127.6 F 003 127.2 F

265 11:57:52
002 127.6 F 003 127.1 F

265 11:59:52
002 127.6 F 003 127.0 F

265 12:01:52
002 127.6 F 003 127.1 F

265 12:03:52
002 127.7 F 003 127.1 F

265 12:05:52
002 127.5 F 003 127.1 F

265 12:07:52
002 127.6 F 003 127.2 F

265 12:09:52
002 127.6 F 003 127.3 F

265 12:11:52
002 127.5 F 003 127.1 F

265 12:13:52
002 127.6 F 003 127.1 F

265 12:15:52
002 127.6 F 003 127.1 F

265 12:17:52
002 127.5 F 003 127.0 F

265 12:19:52
002 127.6 F 003 127.2 F

265 12:21:52

002 127.6 F 003 127.1 F

265 12:23:52
002 127.6 F 003 127.1 F

265 12:25:52
002 127.6 F 003 127.1 F

265 12:27:52
002 127.6 F 003 127.4 F

265 12:29:52
002 127.6 F 003 127.1 F

265 12:31:52
002 127.7 F 003 127.2 F

265 12:33:52
002 127.6 F 003 127.1 F

265 12:35:52
002 127.6 F 003 127.1 F

265 12:37:52
002 127.6 F 003 127.3 F

265 12:39:52
002 127.6 F 003 127.1 F

265 12:41:52
002 127.6 F 003 127.1 F

265 12:43:52
002 127.6 F 003 127.2 F

265 12:45:52
002 127.6 F 003 127.2 F

265 12:47:52
002 127.6 F 003 127.0 F

265 12:49:52
002 127.6 F 003 127.1 F

265 12:51:52
002 127.6 F 003 127.1 F

265 12:53:52
002 127.6 F 003 127.1 F

265 12:55:52
002 127.6 F 003 127.1 F

265 12:57:52
002 127.5 F 003 127.0 F

265 12:59:52

002 127.7 F 003 127.3 F

265 13:01:52
002 127.6 F 003 127.1 F

265 13:03:52
002 127.6 F 003 127.1 F

265 13:05:52
002 127.6 F 003 127.3 F

265 13:07:52
002 127.6 F 003 127.2 F

265 13:09:52
002 127.6 F 003 127.0 F

265 13:11:52
002 127.6 F 003 127.1 F

265 13:13:52
002 127.7 F 003 127.4 F

265 13:15:52
002 127.6 F 003 127.1 F

265 13:17:52
002 127.6 F 003 127.1 F

265 13:19:52
002 127.6 F 003 127.1 F

265 13:21:52
002 127.6 F 003 127.1 F

265 13:23:52
002 127.5 F 003 127.0 F

265 13:25:52
002 127.6 F 003 127.2 F

265 13:27:52
002 127.6 F 003 127.1 F

265 13:29:52
002 127.6 F 003 127.2 F

265 13:31:52
002 127.7 F 003 127.2 F

265 13:33:52
002 127.6 F 003 127.2 F

265 13:35:52
002 127.6 F 003 127.1 F

265 13:37:52

002 127.6 F 003 127.1 F

265 13:39:52
002 127.5 F 003 127.1 F

265 13:41:52
002 127.6 F 003 127.2 F

265 13:43:52
002 127.6 F 003 127.2 F

265 13:45:52
002 127.6 F 003 127.1 F

265 13:47:52
002 127.7 F 003 127.3 F

265 13:49:52
002 127.6 F 003 127.1 F

265 13:51:52
002 127.6 F 003 127.1 F

265 13:53:52
002 127.6 F 003 127.0 F

265 13:55:52
002 127.5 F 003 127.1 F

265 13:57:52
002 127.6 F 003 127.2 F

265 13:59:52
002 127.7 F 003 127.2 F

265 14:01:52
002 127.6 F 003 127.0 F

265 14:03:52
002 127.6 F 003 127.2 F

265 14:05:52
002 127.6 F 003 127.2 F

265 14:07:52
002 127.6 F 003 127.2 F

265 14:09:52
002 127.6 F 003 127.1 F

265 14:11:52
002 127.6 F 003 127.1 F

265 14:13:52
002 127.6 F 003 127.2 F

265 14:15:52

002 127.7 F 003 127.1 F

265 14:17:52
002 127.6 F 003 127.1 F

265 14:19:52
002 127.7 F 003 127.1 F

265 14:21:52
002 127.7 F 003 127.1 F

265 14:23:52
002 127.6 F 003 127.2 F

265 14:25:52
002 127.7 F 003 127.2 F

265 14:27:52
002 127.7 F 003 127.1 F

265 14:29:52
002 127.6 F 003 127.1 F

265 14:31:52
002 127.7 F 003 127.1 F

265 14:33:52
002 127.7 F 003 127.0 F

265 14:35:52
002 127.6 F 003 127.2 F

265 14:37:52
002 127.7 F 003 127.2 F

265 14:39:52
002 127.7 F 003 127.1 F

265 14:41:52
002 127.6 F 003 127.1 F

265 14:43:52
002 127.7 F 003 127.3 F

265 14:45:52
002 127.7 F 003 127.2 F

265 14:47:52
002 127.7 F 003 127.2 F

265 14:49:52
002 127.6 F 003 127.1 F

265 14:51:52
002 127.6 F 003 127.2 F

265 14:53:52

002 127.7 F 003 127.2 F

265 14:55:52
002 127.6 F 003 127.1 F

265 14:57:52
002 127.6 F 003 127.0 F

265 14:59:52
002 127.7 F 003 127.2 F

265 15:01:52
002 127.6 F 003 127.2 F

265 15:03:52
002 127.6 F 003 127.2 F

265 15:05:52
002 127.7 F 003 127.2 F

265 15:07:52
002 127.6 F 003 127.2 F

265 15:09:52
002 127.7 F 003 127.1 F

265 15:11:52
002 127.7 F 003 127.2 F

265 15:13:52
002 127.6 F 003 127.0 F

265 15:15:52
002 127.6 F 003 127.1 F

265 15:17:52
002 127.7 F 003 127.3 F

265 15:19:52
002 127.6 F 003 127.1 F

265 15:21:52
002 127.7 F 003 127.2 F

265 15:23:52
002 127.7 F 003 127.2 F

265 15:25:52
002 127.6 F 003 127.0 F

265 15:27:52
002 127.6 F 003 127.1 F

265 15:29:52
002 127.7 F 003 127.2 F

265 15:31:52

002 127.6 F 003 127.2 F

265 15:33:52
002 127.6 F 003 127.2 F

265 15:35:52
002 127.7 F 003 127.3 F

265 15:37:52
002 127.7 F 003 127.2 F

265 15:39:52
002 127.6 F 003 127.1 F

265 15:41:52
002 127.7 F 003 127.4 F

265 15:43:52
002 127.7 F 003 127.2 F

265 15:45:52
002 127.7 F 003 127.2 F

265 15:47:52
002 127.6 F 003 127.2 F

265 15:49:52
002 127.7 F 003 127.3 F

265 15:51:52
002 127.6 F 003 127.2 F

265 15:53:52
002 127.6 F 003 127.2 F

265 15:55:52
002 127.6 F 003 127.2 F

265 15:57:52
002 127.6 F 003 127.0 F

265 15:59:52
002 127.7 F 003 127.2 F

265 16:01:52
002 127.7 F 003 127.2 F

265 16:03:52
002 127.7 F 003 127.3 F

265 16:05:52
002 127.7 F 003 127.2 F

265 16:07:52
002 127.7 F 003 127.1 F

265 16:09:52

002 127.7 F 003 127.2 F

265 16:11:52
002 127.7 F 003 127.3 F

265 16:13:52
002 127.7 F 003 127.2 F

265 16:15:52
002 127.7 F 003 127.1 F

265 16:17:52
002 127.7 F 003 127.1 F

265 16:19:52
002 127.7 F 003 127.2 F

265 16:21:52
002 127.7 F 003 127.2 F

265 16:23:52
002 127.7 F 003 127.3 F

265 16:25:52
002 127.7 F 003 127.1 F

265 16:27:52
002 127.7 F 003 127.2 F

265 16:29:52
002 127.6 F 003 127.1 F

265 16:31:52
002 127.7 F 003 127.2 F

265 16:33:52
002 127.7 F 003 127.3 F

265 16:35:52
002 127.7 F 003 127.2 F

265 16:37:52
002 127.7 F 003 127.1 F

265 16:39:52
002 127.7 F 003 127.2 F

265 16:41:52
002 127.7 F 003 127.3 F

265 16:43:52
002 127.7 F 003 127.4 F

265 16:45:52
002 127.7 F 003 127.2 F

265 16:47:52

002 127.7 F 003 127.2 F

265 16:49:52
002 127.8 F 003 127.4 F

265 16:51:52
002 127.7 F 003 127.4 F

265 16:53:52
002 127.8 F 003 127.4 F

265 16:55:52
002 127.7 F 003 127.1 F

265 16:57:52
002 127.8 F 003 127.2 F

265 16:59:52
002 127.7 F 003 127.3 F

265 17:01:52
002 127.8 F 003 127.3 F

265 17:03:52
002 127.7 F 003 127.3 F

265 17:05:52
002 127.8 F 003 127.3 F

265 17:07:52
002 127.7 F 003 127.4 F

265 17:09:52
002 127.7 F 003 127.2 F

265 17:11:52
002 127.9 F 003 127.5 F

265 17:13:52
002 127.7 F 003 127.4 F

265 17:15:52
002 127.8 F 003 127.4 F

265 17:17:52
002 127.8 F 003 127.3 F

265 17:19:52
002 127.8 F 003 127.3 F

265 17:21:52
002 127.9 F 003 127.6 F

265 17:23:52
002 127.8 F 003 127.4 F

265 17:25:52

002 127.9 F 003 127.4 F

265 17:27:52
002 127.8 F 003 127.4 F

265 17:29:52
002 127.8 F 003 127.4 F

265 17:31:52
002 127.8 F 003 127.4 F

265 17:33:52
002 127.8 F 003 127.3 F

265 17:35:52
002 127.8 F 003 127.3 F

265 17:37:52
002 127.7 F 003 127.2 F

265 17:39:52
002 127.8 F 003 127.4 F

265 17:41:52
002 127.8 F 003 127.3 F

265 17:43:52
002 127.8 F 003 127.6 F

265 17:45:52
002 127.8 F 003 127.4 F

265 17:47:52
002 127.7 F 003 127.2 F

265 17:49:52
002 127.7 F 003 127.4 F

265 17:51:52
002 127.9 F 003 127.6 F

265 17:53:52
002 127.9 F 003 127.5 F

265 17:55:52
002 127.9 F 003 127.5 F

265 17:57:52
002 127.8 F 003 127.3 F

265 17:59:52
002 127.8 F 003 127.4 F

265 18:01:52
002 127.8 F 003 127.4 F

265 18:03:52

002 127.9 F 003 127.5 F

265 18:05:52
002 127.8 F 003 127.4 F

265 18:07:52
002 127.9 F 003 127.5 F

265 18:09:52
002 127.9 F 003 127.2 F

265 18:11:52
002 128.0 F 003 127.6 F

265 18:13:52
002 127.9 F 003 127.5 F

265 18:15:52
002 127.6 F 003 127.1 F

265 18:17:52
002 128.5 F 003 128.0 F

265 18:19:52
002 128.8 F 003 128.3 F

265 18:21:52
002 128.6 F 003 128.1 F

265 18:23:52
002 128.5 F 003 128.0 F

265 18:25:52
002 128.5 F 003 128.1 F

265 18:27:52
002 128.5 F 003 128.0 F

265 18:29:52
002 128.5 F 003 128.1 F

265 18:31:52
002 128.3 F 003 128.0 F

265 18:33:52
002 128.3 F 003 127.9 F

265 18:35:52
002 128.3 F 003 127.9 F

265 18:37:52
002 127.0 F 003 126.5 F

265 18:39:52
002 127.1 F 003 127.3 F

265 18:41:52

002 126.0 F 003 126.1 F

265 18:43:52
002-****.* F 003-****.* F

265 18:45:52
002-****.* F 003-****.* F

265 18:47:52
002-****.* F 003-****.* F

265 18:49:52
002-****.* F 003-****.* F

265 18:51:52
002-****.* F 003-****.* F

265 18:53:52
002 101.7 F 003 103.4 F

265 18:55:52
002 115.4 F 003 114.7 F

265 18:57:52
002 120.5 F 003 119.7 F

265 18:59:52
002 120.7 F 003 120.1 F

265 19:01:52
002 122.5 F 003 121.8 F

265 19:03:52
002 124.4 F 003 123.4 F

265 19:05:52
002 125.3 F 003 124.4 F

265 19:07:52
002 126.0 F 003 125.2 F

265 19:09:52
002 126.4 F 003 125.6 F

265 19:11:52
002 126.9 F 003 126.1 F

265 19:13:52
002 127.2 F 003 126.3 F

265 19:15:52
002 127.6 F 003 126.9 F

265 19:17:52
002 127.3 F 003 126.7 F

265 19:19:52

002 128.9 F 003 128.3 F

265 19:21:52
002 129.4 F 003 128.8 F

265 19:23:52
002 129.5 F 003 129.3 F

265 19:25:52
002 126.6 F 003 126.6 F

265 19:27:52
002 124.7 F 003 124.8 F

265 19:29:52
002-****.* F 003-****.* F

265 19:31:52
002-****.* F 003-****.* F

265 19:33:52
002-****.* F 003-****.* F

265 19:35:52
002-****.* F 003-****.* F

265 19:37:52
002-****.* F 003-****.* F

265 19:39:52
002-****.* F 003-****.* F

265 19:41:52
002-****.* F 003-****.* F

265 19:43:52
002-****.* F 003-****.* F

265 19:45:52
002-****.* F 003-****.* F

265 19:47:52
002-****.* F 003-****.* F

265 19:49:52
002-****.* F 003-****.* F

265 19:51:52
002-****.* F 003-****.* F

265 19:53:52
002-****.* F 003-****.* F

265 19:55:52
002-****.* F 003-****.* F

265 19:57:52

002-****.* F 003-****.* F

265 19:59:52
002-****.* F 003-****.* F

265 20:01:52
002-****.* F 003-****.* F

265 20:03:52
002-****.* F 003-****.* F

265 20:05:52
002 94.7 F 003 97.9 F

265 20:07:52
002 99.3 F 003 101.9 F

265 20:09:52
002 108.3 F 003 109.4 F

265 20:11:52
002 111.7 F 003 112.7 F

265 20:13:52
002 114.4 F 003 115.1 F

265 20:15:52
002 116.1 F 003 117.1 F

265 20:17:52
002 118.2 F 003 119.0 F

265 20:19:52
002 120.0 F 003 120.7 F

265 20:21:52
002 121.3 F 003 122.1 F

265 20:23:52
002 123.3 F 003 124.4 F

265 20:25:52
002 124.7 F 003 125.4 F

265 20:27:52
002 125.5 F 003 126.5 F

265 20:29:52
002 126.1 F 003 127.0 F

265 20:31:52
002 126.7 F 003 127.6 F

265 20:33:52
002 126.9 F 003 127.6 F

265 20:35:52

002 127.0 F 003 127.9 F

265 20:37:52
002 127.0 F 003 127.8 F

265 20:39:52
002 127.0 F 003 128.0 F

265 20:41:52
002 127.1 F 003 128.0 F

265 20:43:52
002 127.2 F 003 128.0 F

265 20:45:52
002 126.8 F 003 127.7 F

265 20:47:52
002 126.9 F 003 127.6 F

265 20:49:52
002 127.0 F 003 127.9 F

265 20:51:52
002 127.1 F 003 127.9 F

265 20:53:52
002 127.0 F 003 127.8 F

265 20:55:52
002 127.0 F 003 127.9 F

265 20:57:52
002 127.1 F 003 128.0 F

265 20:59:52
002 127.1 F 003 128.0 F

265 21:01:52
002 127.0 F 003 127.9 F

265 21:03:52
002 127.0 F 003 127.9 F

265 21:05:52
002 127.0 F 003 127.9 F

265 21:07:52
002 127.0 F 003 127.8 F

265 21:09:52
002 127.0 F 003 127.9 F

265 21:11:52
002 126.9 F 003 127.8 F

265 21:13:52

002 127.0 F 003 127.9 F

265 21:15:52
002 127.1 F 003 127.7 F

265 21:17:52
002 127.0 F 003 127.8 F

265 21:19:52
002 126.7 F 003 127.7 F

265 21:21:52
002 126.6 F 003 127.5 F

265 21:23:52
002 126.5 F 003 127.3 F

265 21:25:52
002 126.6 F 003 127.5 F

265 21:27:52
002 126.7 F 003 127.5 F

265 21:29:52
002 126.7 F 003 127.5 F

265 21:31:52
002 126.7 F 003 127.6 F

265 21:33:52
002 126.9 F 003 127.6 F

265 21:35:52
002 127.0 F 003 127.7 F

265 21:37:52
002 126.8 F 003 127.5 F

265 21:39:52
002 126.8 F 003 127.7 F

265 21:41:52
002 126.9 F 003 127.9 F

265 21:43:52
002 126.9 F 003 127.6 F

265 21:45:52
002 127.0 F 003 127.9 F

265 21:47:52
002 127.1 F 003 127.9 F

265 21:49:52
002 127.1 F 003 127.9 F

265 21:51:52

002 127.1 F 003 127.8 F

265 21:53:52
002 127.0 F 003 127.8 F

265 21:55:52
002 127.1 F 003 128.0 F

265 21:57:52
002 127.1 F 003 128.0 F

265 21:59:52
002 127.0 F 003 127.9 F

265 22:01:52
002 126.9 F 003 127.8 F

265 22:03:52
002 127.2 F 003 128.0 F

265 22:05:52
002 127.1 F 003 127.6 F

265 22:07:52
002 127.1 F 003 127.6 F

265 22:09:52
002 126.9 F 003 127.8 F

265 22:11:52
002 126.9 F 003 127.8 F

265 22:13:52
002 127.0 F 003 127.6 F

265 22:15:52
002 127.2 F 003 127.7 F

265 22:17:52
002 127.0 F 003 127.8 F

265 22:19:52
002 127.2 F 003 127.8 F

265 22:21:52
002 127.1 F 003 127.8 F

265 22:23:52
002 127.3 F 003 128.1 F

265 22:25:52
002 127.2 F 003 128.1 F

265 22:27:52
002 127.1 F 003 127.9 F

265 22:29:52

002 127.2 F 003 128.0 F

265 22:31:52
002 127.2 F 003 127.7 F

265 22:33:52
002 127.2 F 003 127.7 F

265 22:35:52
002 127.0 F 003 127.8 F

265 22:37:52
002 126.8 F 003 127.6 F

265 22:39:52
002 126.9 F 003 127.4 F

265 22:41:52
002 127.2 F 003 127.6 F

265 22:43:52
002 127.2 F 003 127.6 F

265 22:45:52
002 126.9 F 003 127.6 F

265 22:47:52
002 127.5 F 003 127.8 F

265 22:49:52
002 127.6 F 003 128.5 F

265 22:51:52
002 127.7 F 003 128.9 F

265 22:53:52
002 128.1 F 003 129.1 F

265 22:55:52
002 128.0 F 003 128.8 F

265 22:57:52
002 127.9 F 003 128.6 F

265 22:59:52
002 128.0 F 003 128.5 F

265 23:01:52
002-****.* F 003-****.* F

265 23:03:52
002-****.* F 003-****.* F

265 23:05:52
002-****.* F 003-****.* F

265 23:07:52

002-****.* F 003-****.* F

265 23:09:52
002-****.* F 003-****.* F

265 23:11:52
002-****.* F 003-****.* F

265 23:13:52
002-****.* F 003-****.* F

265 23:15:52
002-****.* F 003-****.* F

265 23:17:52
002 103.6 F 003 103.7 F

265 23:19:52
002 118.6 F 003 115.4 F

265 23:21:52
002 122.0 F 003 120.1 F

265 23:23:52
002 125.1 F 003 123.3 F

265 23:25:52
002 126.5 F 003 124.9 F

265 23:27:52
002 127.1 F 003 125.7 F

265 23:29:52
002 126.7 F 003 125.4 F

265 23:31:52
002 126.3 F 003 125.1 F

265 23:33:52
002 126.2 F 003 125.2 F

265 23:35:52
002 126.3 F 003 125.4 F

265 23:37:52
002 126.5 F 003 125.5 F

265 23:39:52
002 126.6 F 003 125.6 F

265 23:41:52
002 126.7 F 003 125.9 F

265 23:43:52
002 127.0 F 003 126.2 F

265 23:45:52

002 127.3 F 003 126.4 F

265 23:47:52
002 127.1 F 003 126.5 F

265 23:49:52
002 127.5 F 003 127.0 F

265 23:51:52
002 128.3 F 003 127.6 F

265 23:53:52
002 128.4 F 003 127.9 F

265 23:55:52
002 128.5 F 003 127.9 F

265 23:57:52
002 128.5 F 003 127.9 F

265 23:59:52
002-****.* F 003-****.* F

266 00:01:52
002-****.* F 003-****.* F

NASA
National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

BSM-TCP-EP54-004

BSM Delta Qualification Test

Procedure for the Move of the Shipping Container from the Vibration Test Area to the Pyro Shock Test Area

This Procedure Describes **Safety Critical** Operations

BSM-TCP-EP54-004

BSM Delta Qualification Test

Procedure for the Move of the Shipping Container from the Vibration Test Area to the Pyro Shock Test Area

Prepared by:

Mat Bevill EP-12

08/16/93

Motor SN: 1000738

Test Date: 09/23/93

Move Shipping Container to Pyro Shock Area for Delivery

Prepared by:	Mat Bevill/MSFC TE/EP12	09/15/93 Date
Approved by:	Jim McGee/MSFC Vibration Lab TE	9-14-93 Date
	Jim Herring/MSFC Pyro Shock Lab TE	9-14-93 Date
	Richard Leonard/MSFC Safety/CS01	9-16-93 Date
	Rick Clements/MSFC Quality/CQ06	9-15-93 Date
	Ben Goldberg/Motor Systems Division/EP11	9/14/93 Date
	Steve Brewster/Dynamic Test Branch/ED73	9/16/93 Date
	Chuck Wells/UTC/CSD TE	9/16/93 Date
	Don Wenzel/USBI	9-14-93 Date
	Charlie Lovell/PCH Engineer/CN71	9/16/93 Date

Move Shipping Container to Pyro Shock Area for Delivery

Prepared by:

Mat Bevill/MSFC TE/EP12 — 09/15/93 Date

Approved by:

Jim McGee/MSFC Vibration Lab TE — 9-14-93 Date

Jim Herring/MSFC Pyro Shock Lab TE — 9-14-93 Date

Richard Leonard/MSFC Safety/CS01 — 9-16-93 Date

Rick Clements/MSFC Quality/CQ06 — 9-15-93 Date

Ben Goldberg/Motor Systems Division/EP11 — 9/14/93 Date

Steve Brewster/Dynamic Test Branch/ED73 — 9/14/93 Date

Chuck Wells/UTC/CSD TE — Date

Don Wencil/USBI — 9-14-93 Date

Charlie Lovell/PCH Engineer/CN71 — 9/16/93 Date

Table of Contents

1.0 General Information

1.1 Scope

This test procedure addresses all the requirements to move the BSM shipping container from the vibration test area to the pyro shock test area. The shipping container will remain in the pyro shock area until delivery to the NASA igloo.

1.2 Objective of Qualification Tests

The objective of the dynamic testing is to verify the physical and functional survivability of the Booster Separation Motors. Of particular interest for these tests are the components bonded using EA9394 adhesive. The components using this adhesive include the throat insert, the centering insert, and the igniter grain support rod.

2.0 Applicable Documents

MSFC-STD-513A	Certification of Equipment Operations and Materials Handling Personnel
EG5300.36A	Safety
29 CFR 1910	Occupational Safety and Health Administration (OSHA)
NSS/GO 1740.9	Safety Standard for Lifting Devices and Equipment
NHB 1700.1(V1)	Basic Safety Manual
AMC-R 385-100	Safety Manual
EP01-SOP-01	Standard Operating Procedure for Safety Critical Operations
MM 1700.4	Safety and Environmental Health Hazards
MMI 1700.17	MSFC Procedures for Acquiring Shipping Permits for Rocket Motors and Igniters
MMI 1710.1	Safety Review and Approval of Hazardous and Potentially Hazardous Facilities and Activities at MSFC
MMI 1710.6	MSFC Program for Personnel Certification
MMI 1711.2	Mishap Reporting and Investigation

MMI 1845.1	Hazard Communication Program
MMI 6400.2	Packaging, Handling, and Moving Program Critical Hardware
MSFC-RQMT-1493	Electrostatic Discharge Control Requirements
MSFC-STD-1800	Electrostatic Discharge (ESD) Control for Propellant and Explosive Devices
MSFC-STD-126E	Inspection, Maintenance, Proof Testing and Certification of Handling Equipment
CSD-5597-93-1 Rev. B	Enhanced Delta Qualification Test Plan for Booster Separation Motor (BSM), Aug. 6, 1993
10SPC-0067 Rev. A	Specification for Booster Separation Motors for Space Shuttle Solid Rocket Booster (thru SCN 014)

3.0 **Safety**

3.1 The following safety criteria are in accordance with ET01-SOP-01, Rev. A., *Standard Operation Procedures for Safety Critical Operations"*.If safety rules/regulations are not followed,injury to personnel and/or damage to test items could occur.

Emergency telephone numbers are as follows:

Safety	4-0046
Ambulance	112
Fire	117
Security	4-4357
Utilities	4-3919
Medical Center	4-2390
Communication Repair	4-1771

3.2 Prior to starting work in 4619 a visual inspection of work area shall be made for anomalies by task supervisor and safety personnel.

MSFC TE JH MSFC SE RH

Date / Time: 2³⁰ am / 9/23/93

3.3 Personnel shall not work or position themselves beneath suspended loads unless such loads are securely and adequately blocked up.

9-23-93

3.4 Objects handled by overhead hoist shall be lifted only high enough to clear fixed objects in the path of travel. Spreader bars and slings may be left on the hoist if desired when not in use, but must be raised so that the lowest part of the lifting equipment will be at least seven feet from the floor when not in use.

3.5 Crane, hoist, lift prime operators, and riggers shall be certified according to the latest revision of MMI 1710.6, and shall have in their possession a valid certification card.

Certifications checked by: MB

Date / Time: 09/23/93

3.6 Personnel working around suspended loads shall be alert to the possibility of being crushed between the suspended load and a fixed object.

3.7 Loads shall be moved slowly so they will not accumulate more momentum than can be stopped with little or no swing.

3.8 Where handling slings are called out, a sling with more pickup points than required may be used if the weight capacity per point used is equal or greater than the weight capacity of each point of the noted sling and the free pickup point is (are) secured to prevent it (them) from swinging and causing damage to parts.

3.9 Only the area coordinator should direct the crane moves, however, any person determining an immediate danger or problem may request stoppage of activities.

3.10 The lifting or transportation operation shall be halted by the area coordinator at any time the control area cannot be maintained.

3.11 Steel toe shoes are required during lifting operations. Hardhats are required when the lift is at or above the shoulders.

3.12 Tag line operators are to wear leather gloves.

3.13 The primary safety hazards associated with this operation are:

3.13.1 Lift operations
3.13.4 Live (Loaded) Solid Rocket Motor

9-23-93

3.14 Any time a crane is being used, it must be dogged if:

3.14.1 The load will be suspended in a static condition for an extended amount of time.

3.14.2 A crane operator crew change or substitution must be made.

3.15 Inspection certifications shall be provided for the forklift used to lift the motor shipping container.

Forklift certification provided JH MSFC TE

3.16 No electric power tools shall be used near the live test item. Use of pneumatic tools is acceptable.

3.17 All ground cables and ground straps end-to-end resistances shall be verified with a multimeter. These resistances must measure less than 1 ohm.

3.18 All personnel within touching distance shall wear a wrist strap that has been checked with a wrist strap checker. This step should be performed each time the wrist strap ground is broken.

3.19 All personnel within touching distance of open grain propellant (and ordnance) shall wear antistatic coveralls.

4.0 Test Items, Test Equipment, and Move Procedure

4.1 Test Items

For this procedure, the test item should already be placed in its shipping container and secured to its shipping pallet.

Motor Serial Number for this move: 1000738

4.2 Test Equipment

4.2.1 Proof Loading of Handling Equipment (required for PCH)

4.2.1.1 The heaviest lift during all of the delta qualification testing will be lifting the motor while in its shipping container. The motor and shipping container together weigh about 310 lbs. All forklifts and overhead hoists must be load (break) tested to at least 110% of this weight (i.e. 350 lbs.). This test must be performed prior to any handling of the BSM but does not need to be repeated until something other than the BSM is lifted by the same handling equipment. It is therefore recommended that [4

9-23-93

the break tests be performed each evening before the BSM testing commences. The break tests shall be performed as follows:

a. The proof load must be at least 350 lbs.

b. Lift the dummy load clear of the ground (less than 1 foot) and lower to ground three times, holding for five minutes on the third lift. Lifting straps and spreader bar should be attached during the lift.

SEE APPENDIX C FOR THE PROOF TEST INSPECTION SHEETS.

4.3 Move Procedure

4.3.1 After review and documented approval, a redline change to this procedure may be performed. Approval shall be by a minimum of Test Engineer.

4.3.2 As soon as possible after a test failure, a deviation from the specified test environment, or any other incident which affects the test or test item, MSFC will notify the authorized UT/CSD representative of the event verbally and will then generate a Test Procedure Deviation (NASA form 3959). A copy of the Test Procedure Deviation is presented in Appendix A. Photographs of any discrepancies shall also be taken.

5.0 <u>Personnel Responsibilities</u>

5.1 Weather

5.1.1 The MSFC TE is responsible for checking the weather conditions before the move. The test site's relative humidity must be above 20%. If the humidity is not above 20%, all move operations will be postponed until favorable weather conditions resume.

Test site relative humidity: 87% MSFC TE

5.1.2 It is not recommended to transport the motor in the rain. However, if the motor must be moved during the rain, cover the motor with Velostat sealed with conductive tape.

5.1.3 The MSFC TE shall check with the Army MET team to ensure that there is no lighting within 10 miles. (MET team phone number....876-2465). [✓]

9-23-93

5.1.4 If lightning is within 10 miles during any time that a live BSM is in building 4619, the MSFC TE shall make arrangements to disconnect the motor ground from the facility ground. The motor shall remain ungrounded until the lightning is out of range.

5.1.5 When reconnecting the ground after a lightning storm, a 100Kohm resistor should be connected to the ground wire from the motor before connecting to facility ground. This allows any charge on the motor to slowly dissipate to ground. The resistor should be left connected for no less than 30 seconds.

5.1.6 After the specified time, disconnect the ground wire from facility ground and remove the resistor. Reconnect the ground strap from the motor to facility ground.

5.2 **Move Witnessing**

The move will be witnessed by a minimum of the MSFC TE, MSFC SE, and the MSFC QA.

5.3 **The MSFC TE will serve as the area coordinator for the test. All handling of the BSM will be directed by the MSFC TE or cognizant test engineer.**

5.4 **Jim McGee (vibration) shall be responsible for photographic coverage of the move activities.**

5.5 **All involved lab directors and division chiefs shall be notified prior to testing.** [ ]

5.6 **The MSFC TE shall make arrangements for the live BSM to be transported from the vibration lab to the pyro lab.** [ ]

5.7 **The MSFC TE shall call security (4-4357) to arrange for a motor escort to the pyro lab.** [ ]

6.0 **Transport Truck Preparation**

6.1 The area around the outside of the pyro shock facility shall be secured before the live BSM is brought to the pyro shock test site. [ ]

Area secured? YES NO

_____ MSFC TE
_____ MSFC SE

Comments: ______________________

9-23-93

6.2 Have a certified truck ready to transport the test item to the pyro test room. The truck's engine will be off and at least one wheel chocked. [✓]

Truck's wheel braked and chocked: ________ MSFC TE

6.3 MSFC TE shall call security and arrange for an escort. [✓]

7.0 **Load Shipping Container onto Truck**

CAUTION: Make sure the ground wire connecting the shipping container to facility ground is long enough to reach the bed of the truck. If not, switch to a longer strap. REMEMBER TO MAKE NEW GROUND BEFORE BREAKING THE OLD GROUND. Verify resistance as required.

CAUTION: Be careful not to disconnect the ground wire during this move.

7.1 Use the fork lift to place the shipping container on the explosive certified truck. The MSFC TE shall designate someone to keep the ground wire out of the way during this move. [✓]

7.2 Attach a ground strap to the truck chassis and verify its resistance. Measure the resistance from the end of the ground strap to a location on the truck chassis right next to the ground connection. The reason for this check is to make sure that there is a good connection to the motor chassis. Resistance shall measure less than 1 ohm. [✓]

Resistance measured: 0.1Ω MSFC QA ________

7.3 Attach the chassis ground strap to the shipping container. [✓]

7.4 Verify truck to shipping container ground. Measure resistance from right next to the chassis connection to the shipping container connection. Resistance shall measure less than one (1) ohm. [✓]

Resistance measured: 0.1Ω MSFC QA ________

7.5 Disconnect the shipping container to test cell ground. [✓]

7.6 Secure the shipping container in the truck bed. [✓]

8.0 **Transport Motor to Pyro Area/Unload Motor From Truck**

8.1 The motor carrying truck and escort personnel shall follow the route provided in Figure 1 moving at a maximum speed of 10 m.p.h. [✓]

9-23-93

8.2 Fork lift shall proceed to the point designated on Figure 1 as "destination." [✓]

8.3 Upon arrival at the destination, the truck will turn off its engine, engage the emergency brake, and chock at least one wheel. [✓]

Truck's wheel braked and chocked: JK MSFC TE

CAUTION: Make New Ground Before Braking Old Ground.

8.4 Attach a ground wire to the pyro facility ground and verify its resistance. Resistance shall measure less than 1 ohm. [✓]

Resistance measured .1 MSFC QA

8.5 Attach the ground wire to the motor shipping container. Verify the resistance (should measure less than 1 ohm). [✓]

Resistance measured .1 MSFC QA

8.6 Disconnect the ground strap between the motor and the truck chassis. [✓]

CAUTION: Be careful not to disconnect the ground wire during the following move.

8.7 Use the fork lift to remove the shipping container from the truck. The MSFC TE shall designate someone to keep the ground strap out of the way during unloading. [✓]

8.8 Place the shipping container near the center of the room. [✓]

8.9 Clear area. Close and lock the doors to the pyro facility. [✓]

8.10 ***All pyro shock operations shall not commence until the BSM motor has been removed.***

9.0 Load Motor for Delivery to NASA Igloo

9.1 Park truck outside the pyro room doors. Leave adequate space for fork lift maneuvering. [✓]

9.2 Turn off the truck's engine, engage the emergency brake, and chock at least on of the truck's wheels. [✓]

Truck braked and wheel chocked: MB MSFC TE

9-23-93

9.3 Attach a ground wire to the truck chassis and verify the resistance. The resistance should measure less than 1 ohm. [✓]

Resistance measured: 0.1 Ω MSFC QA RL

CAUTION: Be careful not to disconnect the ground wire during the following move.

9.4 Use the fork lift to place the shipping container on the explosive certified truck. The MSFC TE shall designate someone to keep the ground wire out of the way during this move. [✓]

9.5 Attach ground wire from the truck chassis to the shipping container. Verify resistance with an ohm meter (should be less than 1 ohm). [✓]

Resistance measured: 0.1 Ω MSFC QA RL

9.6 Disconnect the shipping container to facility ground wire. [✓]

9.7 Secure the shipping container in the truck bed for delivery. [✓]

9.8 Delivery truck may now exit. [✓]

9-23-93

10.0 **Post Test Verification**

The procedure delineated in the above document has been satisfactorily completed and :

a. All sequences in the procedure have been completed (or deleted by approved deviation)

b. All Procedure changes have been recorded and approved.

Submitted Verified by: Mat Bevill
Test Engineer

Date: 09/23/93

Motor serial number: 1000738

9-23-93

Appendix A

Test Procedure Deviation

Figure 1

TEST PROCEDURE DEVIATION

TEST PROCEDURE DEVIATION			TCP NO.:
TEST ENGINEER:	QUALITY		DATE
REQUIREMENTS ENGINEER:	OTHER:		
TITLE:			SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 1

TEST PROCEDURE DEVIATION

TCP NO.:

TEST ENGINEER:

QUALITY

DATE

REQUIREMENTS ENGINEER:

OTHER:

TITLE:

SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:

ORGANIZATION:

ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:

SAFETY:

ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 1

TEST PROCEDURE DEVIATION

EST ENGINEER:	QUALITY	TCP NO.:
REQUIREMENTS ENGINEER:	OTHER.	DATE
TITLE:		SHEET OF

DEV. NO.	PAGE	SEQ.	CHANGE/REASON	PERM/ TEMP.

ORIGINATOR:		ORGANIZATION:
ABOVE DEVIATION(S) INCREASE HAZARD LEVEL:	SAFETY:	ABOVE DEVIATION(S) AFFECT TEST REQUIREMENTS.

Figure 2

DEVIATION LOG

PROCEDURE ______________ REVISION ______________

DEV NO.	PAGE	PARA STEP	REASON/REMARKS	P/T	DATE ISSUED	DATE SIGNED

Appendix B

Figures

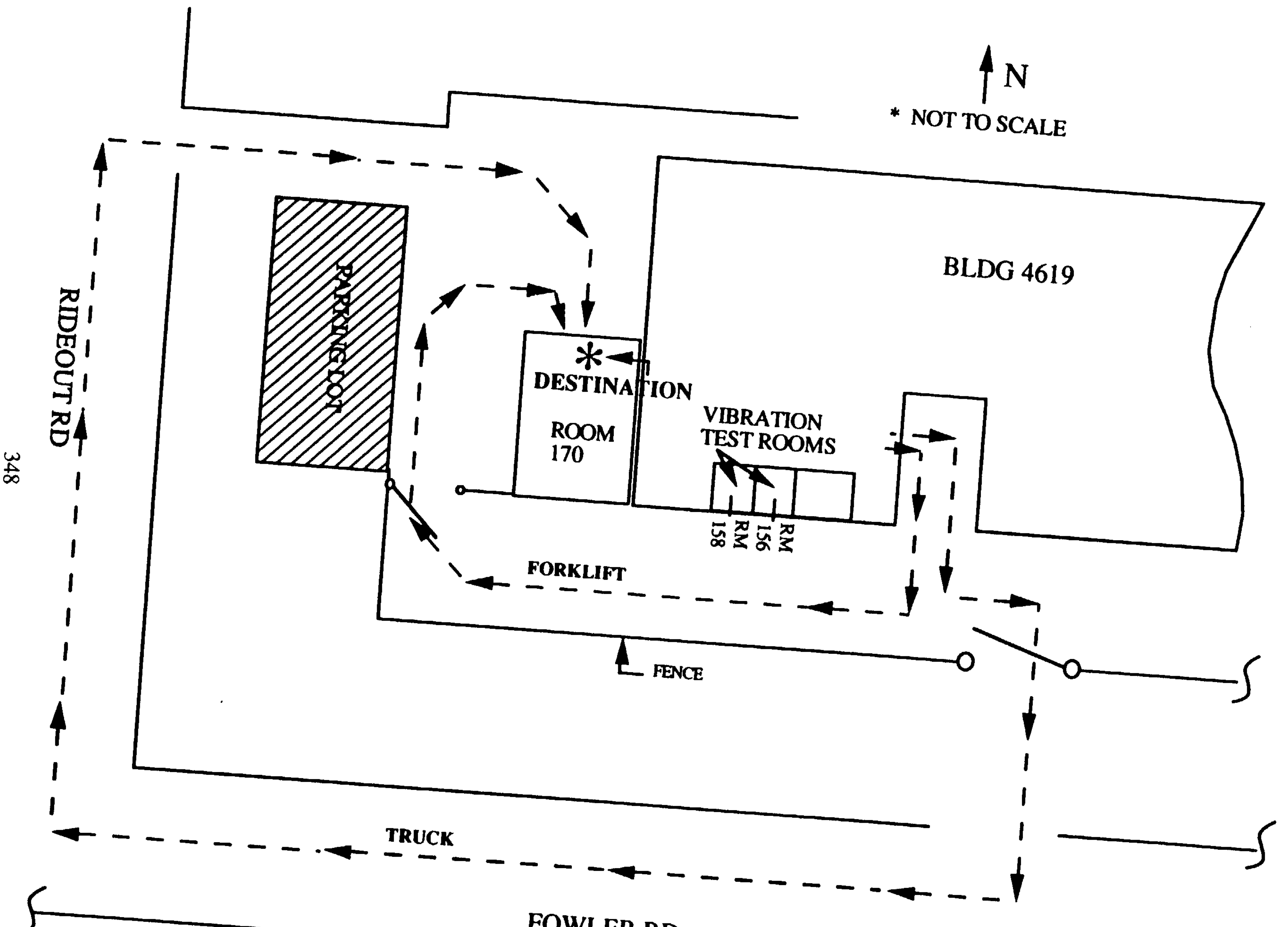


FIGURE 1. TRUCK ROUTE TO PYRO SHOCK AREA

DRAWN BY:
K.MITCHELL/EP54
4/14/93

Appendix C

Proof Test Inspection Sheet

Lifting Equipment Inspection Sheet

1. **PCH Identification**
   a. Nomenclature:
   b. SN:

2. **Handling Procedure Number**

3. **Location of Lift (Fac. Bldg.)**
   a. Building: ____________
   b. Date of lift: ____________

4. **Weight to be Lifted (in lbs.)**
   a. Item: ____________
   b. Hoisting Equipment ____________
   c. Total: ____________

5. **Checklist**
   a. Assessment Prior to Critical Lift
      1. Maintenance records ____________
      2. Equipment tagged with appropriate max working loads ____________
      3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
      4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

   b. Operator's Certification Validation:

      Crane ____________ Rigger ____________ Flagman ____________

      Forklift ____________ Driver ____________ Personnel Hoist ____________

   c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

   d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. **For additional information, observations and remarks**

____

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

Lifting Equipment Inspection Sheet

1. PCH Identification

a. Nomenclature:

b. SN:

2. Handling Procedure Number

3. Location of Lift (Fac. Bldg.)

a. Building: ____________

b. Date of lift: ____________

4. Weight to be Lifted (in lbs.)

a. Item: ____________

b. Hoisting Equipment ____________

c. Total: ____________

5. Checklist

a. Assessment Prior to Critical Lift

1. Maintenance records ____________
2. Equipment tagged with appropriate max working loads ____________
3. Load to be lifted does not exceed max working load of hoisting equiptment as configured ____________
4. Assessment prior to critical lift complete per MSFC-STD-126E ____________

b. Operator's Certification Validation:

Crane ____________ Rigger ____________ Flagman ____________

Forklift ____________ Driver ____________ Personnel Hoist ____________

c. Visual inspection shows no evidence of damage, excessive wear or abuse. ____________

d. Dummy load lift of ________ lbs. completed and no discrepancies noted. ____________

6. For additional information, observations and remarks

____

____

____

I certify that the critical lifting equipment and personnel have been reviewed and found to be in compliance with the requirements of MSFC-STD-126E.

MSFC PCH Move Manager ____________ Date ____________

MSFC Safety ____________ Date ____________

MSFC Quality ____________ Date ____________

This page intentionally left blank

Appendix C

DELTA QUALIFICATION TEST PLAN

CSD-5597-93-1 Rev B
22 August 1993

Program 5597

BOOSTER SEPARATION MOTOR FOR THE ENHANCED DELTA QUALIFICATION TEST PLAN

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

Prepared by:

Charles E. Wells 8/10/93
C. E. Wells
Senior Structural Analyst

Concurrence:

K O Murphy for B.A. Goldstone 8/10/93
B. A. Goldstone, Chief
Structural Analysis

K O Murphy 8-10-93
L. O. Murphy
BSM Chief Engineer

M. T. Kiskila 8/10/93
M. T. Kiskila
Quality Engineer

T. V. O'Hara 8-10-93
T. V. O'Hara
BSM Program Manager

PRECEDING PAGE BLANK NOT FILMED

1.0 INTRODUCTION

This test plan defines the delta qualification tests to be performed for the Booster Separation Motor (BSM) Program. These tests will verify the ability of the enhanced BSM (B12000-13/14-01) to withstand adverse environmental conditions and to perform within specification requirements. The qualification test sequence called out in the test plan includes temperature cycling, vibration (at 25 degrees and 125 degrees F), shock (ambient temperature), post-environmental x-ray and static testing. The new design configuration will be qualified by similarity to the following 10SPC-0067 environments: Altitude cycling, rain, humidity, salt fog, 45 day aging and altitude start. This is considered an acceptable verification approach since the design changes are internal to the BSM and are isolated from all environments except temperature and dynamics.

This delta qualification program is being conducted to qualify specific design/producibility enhancements incorporated into the BSM as defined in motor configuration, B12000-13/14-01. The specific design changes of interest are:

Vulcanized nozzle closure insulator (see Vulcanization Test Plan DTP-5597-001).

Adhesive EA9394 used to bond throat and igniter components (Test plan for EA 9394 Qualification is provided as Appendix B).

Iso static molded ATJ bulk graphite throat material.

Deleted igniter adapter insulator ring.

Deleted igniter adapter/igniter case interface RTV.

Replace chlorinated solvents with "environmentally friendly" solvents (bond surface preparation)

Delete Loctite from Igniter retainer plate and Igniter grain rod

Two BSMs from Lot AAY, Batch 400-3256, will be subjected to the environmental conditions as specified in Figure 1-1. Figure 1-2 provides definition of the sequence for testing and the associated inspections. Environmental testing will be completed per a CSD approved test procedure which complies with the requirements defined herein.

The motor static firing will be conducted per SE0837 and the additional requirements of this plan. Following completion of all testing, both environmental and static, the delta qualification motors will undergo post-test evaluations.

The recorded performance data together with motion picture coverage will provide the verification documentation for the delta qualification of the BSM configuration, B12000-13/14-01.

Figure 1-1. DELTA QUALIFICATION TEST MATRIX

CONFIGURATION/CONDITIONS	DELTA QUAL MOTOR #1	DELTA QUAL MOTOR #2
NUMBER OF INITIATORS		
Double (static test only)	X	X
PRE-FIRE CONDITIONS		
Temperature Cycling	X	X
Lift-off, Boost, and Vehicle Dynamics Vibration at Temperature		
25° F	X	
125° F		X
Ordnance Shock at Ambient	X	X
MOTOR FIRING CONDITIONS		
Pre-Static Test X-ray	X	X
Test Temperature		
25° F	X	
125° F		X
Sea Level Ignition	X	X

Note: Since neither Aeroheat Shield or aft heat seal modifications are involved, neither will be included in these Delta-Qualification static firing tests at 25° F and 125° F. Aeroheat Shields will be on the motors during environmental testing.

Figure 1-2. DELTA QUALIFICATION TEST SEQUENCE

TEST ENVIRONMENT	**#1**	**#2**
Serial Number	1000734,Aft	1000738,Fwd
Temperature Cycling	1	1
Lift-off Vibration*	2	2
Boost Vibration*	2	2
Vehicle Dynamics Vibration*	2	2
Vibration Conditioning Temp.	25+0/-5°F	125+5/-0°F
Ordnance Shock*	2	2
Pre-static Test X-ray	3	3
Motor Static Firing	4	4
Conditioning Temperature	20+0/-5°F	130+5/-0°F
Post-Test Inspection	5	5

* Conducted at MSFC test facilities

Note: Lift-off, boost, and vehicle dynamics vibration as well as ordnance shock may be performed in any sequence to save cost or schedule.

2.0 OBJECTIVES

The objective of the environmental tests is to demonstrate the capability of the BSM to sustain defined temperature cycling and vibration/shock environments. The environments combine both aft and forward BSM criteria for both the RSRB and ASRB.

The objective of the motor static firings is to demonstrate that the enhanced BSM meets the USBI 10SPC-0067A performance requirements after sustaining the environmental tests. A test report will be written documenting all testing with results and verification to all component and motor performance delta qualification requirements of the 10-SPC 0067 specification.

3.0 SUCCESS CRITERIA

The success criteria for the design changes and for each of the tests is described separately below.

3.1 DESIGN CHANGES SUCCESS CRITERIA

The success criteria for each of the design changes listed on page 1 of this test plan and the combination environmental tests are listed below:

(1) Vulcanized Insulator
Demonstrate ability to remain in place during static test and demonstrate ablative capabilities that show no more than one-half (90 mils) of the insulator to be eroded during the static test. Verification to be obtained through post-test 0° - 180° section measurements of fired nozzle closure insulation (Ref. Appendix A) with comparison to sectioned development vulcanized insulator thicknesses.

(2) EA 9394 Adhesive
Demonstrate ability to retain nozzle throat and igniter components in place during static test such that their performance is unaffected. Pre and post-test visual examinations will verify throat performance. Pre-test x-ray and post-test sectioning will verify Igniter component joint performances.

(3) Iso-Static Molded ATJ Bulk Graphite Throat
Demonstrate ability to withstand environmental and static test environments as evidenced by maintaining structural integrity (no cracks) and allowing loaded motor to meet program ballistic requirements.

(4) Deleted Igniter Adapter Insulator Ring
Demonstrate Adapter performance with no evidence of surface melting (debris).

(5) Demonstrate overall motor performance to meet ballistic and structural requirements when subjected to combined aft/fwd and SRB/ASRB environmental loads. Verification to come from Appendix A inspections for items 1 - 5 above and normal post-test inspections.

3.2 TEMPERATURE CYCLING SUCCESS CRITERIA

The demonstration of the ability to withstand temperature cycling will be satisfied if the specified environments of paragraph 5.1 are imposed on the test units and (1) motor component structural integrity is maintained, (2) subsequent pre-static test x-rays show no propellant cracks or debonds, and (3) there is no adverse effect on motor firing performance.

3.3 PRE-FIRE VIBRATION AND SHOCK SUCCESS CRITERIA

The pre-fire environments include lift-off, boost, and vehicle dynamics vibration and ordnance shock. The demonstration of the ability to withstand these environments will be satisfied if the specified environments of paragraphs 5.2 and 5.3 are imposed on the test units and (1) motor component structural integrity is maintained, (2) subsequent pre-static test x-rays show no propellant cracks or debonds, and (3) there is no adverse effect on motor firing performance.

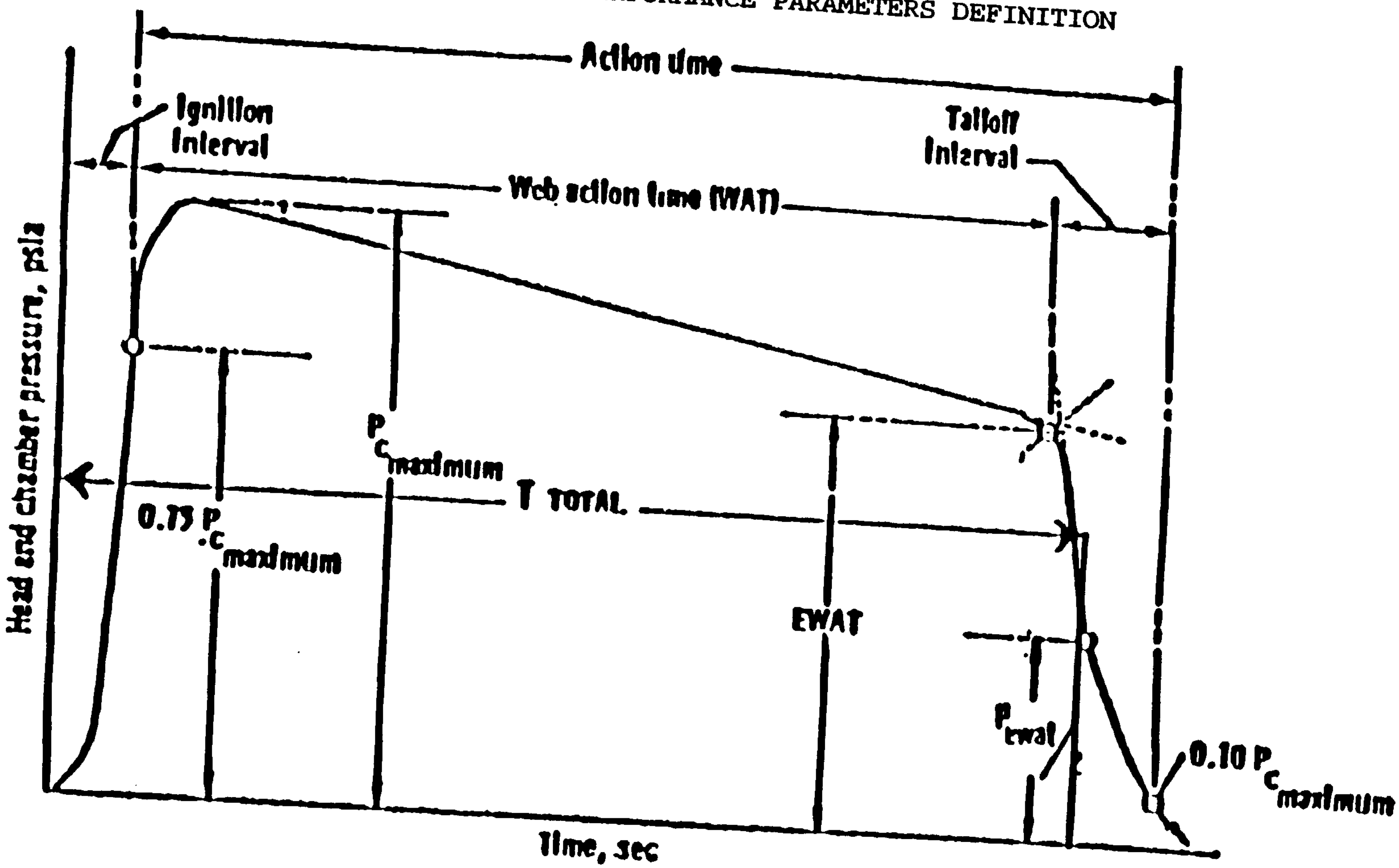
3.4 MOTOR STATIC FIRING SUCCESS CRITERIA

Verification of the motor ballistic performance will be satisfied if the data indicates compliance with the following requirements:

Total Impulse	
Web Action Time, lb-sec	14,000 min
Action Time, lb-sec	15,000 min
Maximum Thrust, lb	29,000 max
Web Action Time	
Average Thrust, lb	18,500 min
Time, sec	
$T_{Ignition}$	0.030 min 0.100 max
T_{Web}	0.805 max
T_{Total} = T_{Ign} to T_{pc} EWAT/2	1.050 max
Pressure at EWAT, psia	2,000 max
Propellant Bulk Temperature, °F	30 to 120
External Case Temperature, °F	290 max at soak out
Max Expected Operating Pressure (MEOP)	2220 psi

Figure 3.3-1 shows a pressure time curve which defines the important performance parameters.

Figure 3.3-1 BSM PERFORMANCE PARAMETERS DEFINITION



4.0 PRE-TEST NDE

1) The pre-test CSD NDE will consist of visual inspections and x-rays of the loaded motor cases. X-rays will be taken at 0°, 45°, 90° and 135° to verify the following:

   (a) Cracks - none allowed.

   (b) Voids - any void or combination of voids shall not decrease the propellant web thickness to less than 0.3 inches. The sum total increase in burning surface area at any time due to the combined effects of all surface or subsurface voids and flashing shall not be greater than 16 square inches.

   (c) Separations/Unbonds - none allowed.

2) The pre-test CSD NDE of the Igniter Assembly will consist of a side view x-ray to verify that all components are there and correctly in place.

3) The pre-test CSD NDE of the Nozzle Closure Assembly bonded insulators will consist of the following:

   (a) Ultrasonic and tap tests to verify that on the forward part of the insulator near the graphite throat bond that the total cumulative area of unbond not exceed 2 square inches.

   (b) ultrasonic and tap tests to verify that on the remainder of the insulator bond area extending to the O.D. no single unbond area shall exceed 5 square inches and the maximum total cumulative unbond area not exceed 10 square inches.

   (c) Edge Bond tests on the O.D. to verify that no unbonds greater than 0.125 inches deep and 1.5 inches in circumferential length for an individual unbond or a maximum cumulative length of 5.0 inches exist.

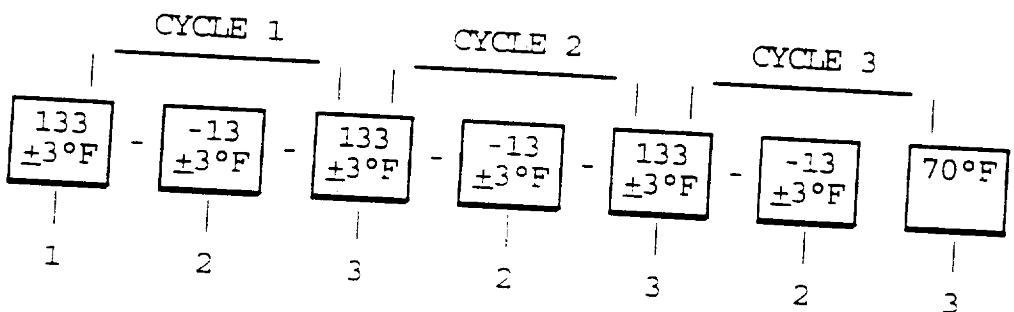
5.0 ENVIRONMENTAL TEST DESCRIPTION

The environmental tests include (1) temperature cycling, (2) lift-off, boost, and vehicle dynamics vibration, and (3) ordnance shock. All test measurements will be made with instruments whose calibration is traceable to the National Bureau of Standards. Test tolerances will be as specified in MIL-STD-810D, unless otherwise specified.

Each environment will be discussed separately below.

5.1 TEMPERATURE CYCLING

Both motors will be subjected to three continuous temperature cycles at CSD per the following sequence:



<u>Procedure:</u>

(1) Hold the motors at a stabilized average air temperature of 133±3°F for 24 hours minimum.

(2) Subject the motors -13±3°F within five minutes of removal from the 133° conditioning. Hold the motors at a stabilized average air temperature of -13±3°F for 24 hours minimum.

(3) Subject the motors 133±3°F within five minutes of removal from the -13° conditioning. Hold the motors at a stabilized average air temperature of 133±3°F for 24 hours minimum.

(4) After repeating steps (2) and (3) two more times (a total of three cycles), allow the motors to recover to ambient temperature (approximately 70°F) prior to further processing.

The total temperature cycling period is approximately seven days.

NOTE: Conditioning period starts after the average air temperature inside the conditioning chamber stabilizes at the required temperature. Should the motor be out of conditioning tolerances for greater than 30 minutes, it must be reconditioned for twice the time out of tolerance.

5.2 VIBRATION (Lift-off, Boost and Vehicle Dynamics)

All vibration testing will be completed at MSFC employing existing test fixtures used for vibration testing of the adhesive test motor (Ref. MSFC test report ED73 (93-05, Dated 14 January 1993).

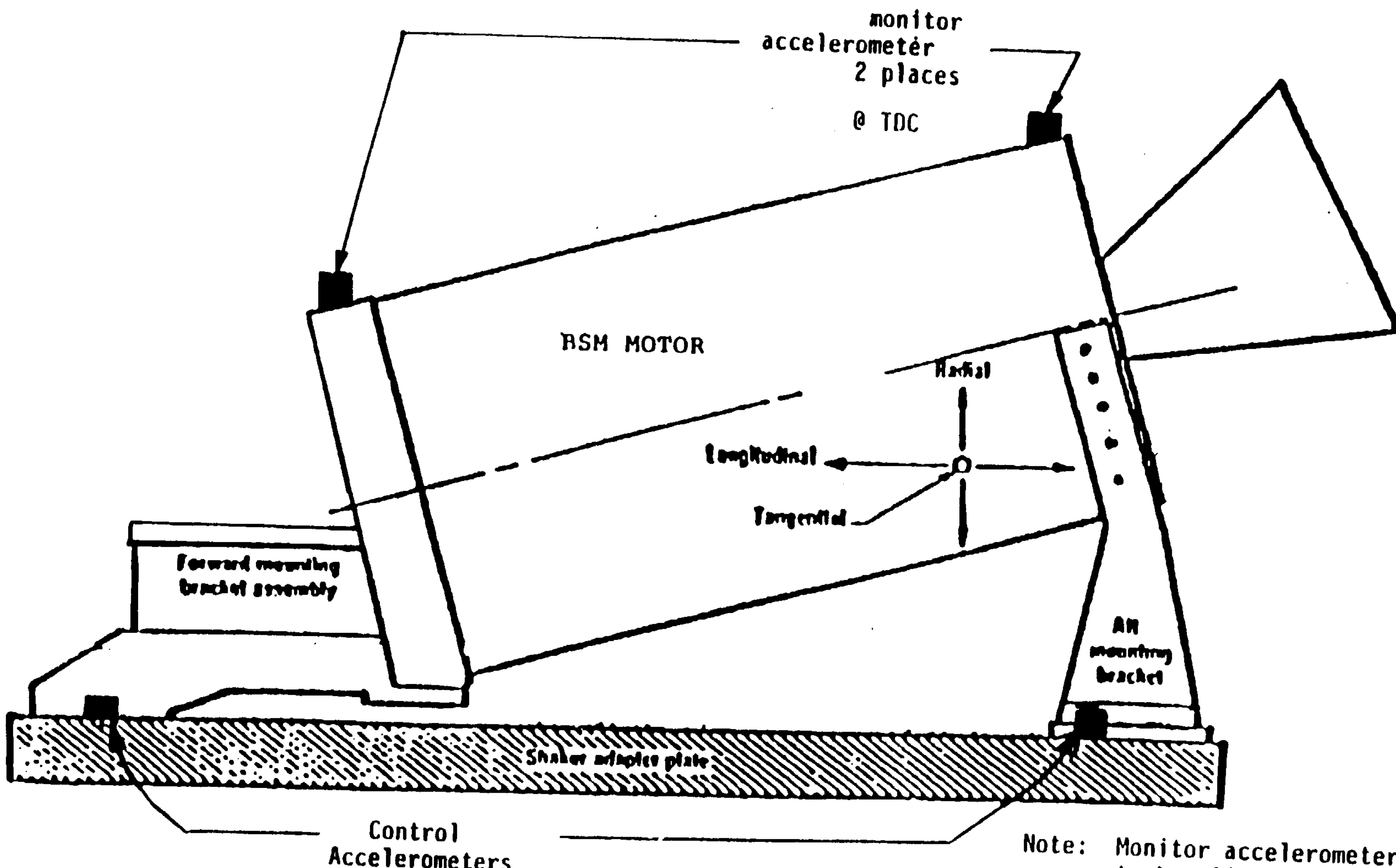
Both motors will be temperature conditioned for a minimum of 24 hours prior to vibration, and shall be maintained at temperature during vibration. One motor will be conditioned to 125+5/-0°F and the other to 25+0/-5°F. The conditioning period starts after the average air temperature inside the conditioning chamber stabilizes at the required temperature. Should the motor be out of conditioning tolerances for greater than 30 minutes, it must be reconditioned for twice the time out of tolerance.

The motors will be mounted in a USBI supplied flight-type aft BSM bracket. This bracket mounts a single BSM to the SRB aft skirt. The bracket holds the BSM centerline at an 18° 40' angle to its base.

Vibration will occur in each of three orthogonal axes defined in Figure 5.2-1. The control signal will be the average of two accelerometers located on the fixture near the bracket/fixture interface. One control accelerometer will be located near the bracket at the forward end of the BSM and one near the aft. Two triaxial response accelerometers will be located as shown in Figure 5.2-1. The response accelerometers will be oriented in the test axes shown in Figure 5.2-1.

The lift-off, boost, and vehicle dynamics vibration environments are shown in Figures 5.2-2 through 5.2-4. Vibration to these environments may be performed in any sequence. This includes completing all three environments in one axis of excitation before moving to the next.

A visual inspection of the BSM motors will be performed between each axis of excitation.



Note: Monitor accelerometers to be aligned with vibration axes as shown.

Figure 5.2-2. **LIFT-OFF RANDOM VIBRATION CRITERIA**
60 **Seconds/axis**

RADIAL AXIS					
		20	Hz @	0.017	g^2/Hz
20	-	55	Hz @	+6	dB/oct
55	-	200	Hz @	0.077	g^2/Hz
200	-	280	Hz @	-11	dB/oct
280	-	1200	Hz @	0.022	g^2/Hz
1200	-	2000	Hz @	-4.5	dB/oct
	-	2000	Hz @	0.010	g^2/Hz
Composite = 6.9 g_{rms}					

LONGITUDINAL AND TANGENTIAL AXES					
		20	Hz @	0.016	g^2/Hz
20	-	75	Hz @	+3	dB/oct
75	-	1000	Hz @	0.060	g^2/Hz
1000	-	2000	Hz @	-3	dB/oct
		2000	Hz @	0.030	g^2/Hz
Composite = 10.0 g_{rms}					

Figure 5.2-3. **BOOST RANDOM VIBRATION CRITERIA**
120 **Seconds/axis**

RADIAL AXIS						
20	-	200	Hz @	0.54	g^2/Hz
200	-	350	Hz @	-12	dB/oct
350	-	1000	Hz @	0.060	g^2/Hz
1000	-	2000	Hz @	-6	dB/oct
	-	2000	Hz @	0.015	g^2/Hz
Composite = 14.0 g_{rms}					

LONGITUDINAL AND TANGENTIAL AXES					
20	-	800	Hz @	0.24	g^2/Hz
800	-	2000	Hz @	-4	dB/oct
		2000	Hz @	0.071	g^2/Hz
Composite = 18.4 g_{rms}					

Figure 5.2-4. VEHICLE DYNAMICS CRITERIA
3 octave/minute sweep rate

RADIAL AXIS					
2	-	5	Hz @	2.0	g's peak*
5	-	10	Hz @	0.7	g's peak
10	-	40	Hz @	3.7	g's peak
LONG. AND TANGENTIAL AXES					
2	-	5	Hz @	4.3	g's peak*
5	-	10	Hz @	0.7	g's peak
10	-	40	Hz @	4.3	g's peak

*Design criteria only

5.3 ORDNANCE SHOCK

Shock tests will be performed on both BSM motors at ambient temperature conditions (75±15°F). Tests will be performed by applying one shock by ordnance or six shocks (one in each direction of each axis) by mechanical methods to the levels shown in Figure 5.3-1. CSD will provide a mass simulator for calibration of shock test setup.

All shock testing will be completed at MSFC employing the existing test fixtures used for shock testing of the adhesive test motor (Ref. MSFC test report No. ED73 (93-10) dated 15 January 1993).

Figure 5.3-1. SHOCK TEST CRITERIA

ORDNANCE SHOCK RESPONSE SPECTRUM (Q=10)						
		50	Hz @	24	g's peak
50	-	100	Hz @	+12	dB/oct
		100	Hz @	94	g's peak
100	-	4000	Hz @	+6	dB/oct
4000	-	10000	Hz @	3750	g's peak

Shock spectrum tolerance: ±6 dB

6.0 STATIC TEST DESCRIPTION

6.1 FACILITY REQUIREMENTS

The BSM static tests will be performed in test bay ST-3 using the existing six component thrust mount. A schematic of the motor and test stand arrangement is shown in Figure 6.1-1. The test stand accuracy will be ±2% for thrust measurements, ±1% for pressure, and a flat frequency response width of 1 dB between 0 to 15 Hz.

In addition, control and data acquisition station 1310 and temperature conditioning chambers will be used.

Both delta-qualification motors will use dual initiators since no design changes were incorporated that would impact ignition characteristics.

6.2 PRETEST ACTIVITIES

Pre-static test activities will include the following with CSD QC verification of data acquisition:
NOTE: All test anomalies will be documented and reported by Test Engr.

(a) Prefire measurements in accordance with SE0837, Table II. (see figure 6.2-1)

(b) Prefire still photographs of the motor.

(c) Environmental Tests per Sections 5.1 through 5.3
  - Temperature Cycling
  - Lift-off, boost, and vehicle dynamics vibration
  - Ordnance shock

(d) Pre-static test NDE
  - Visual
  - X-ray

(e) Install instrumentation in accordance with SE0837 and Figure 6.2-2.

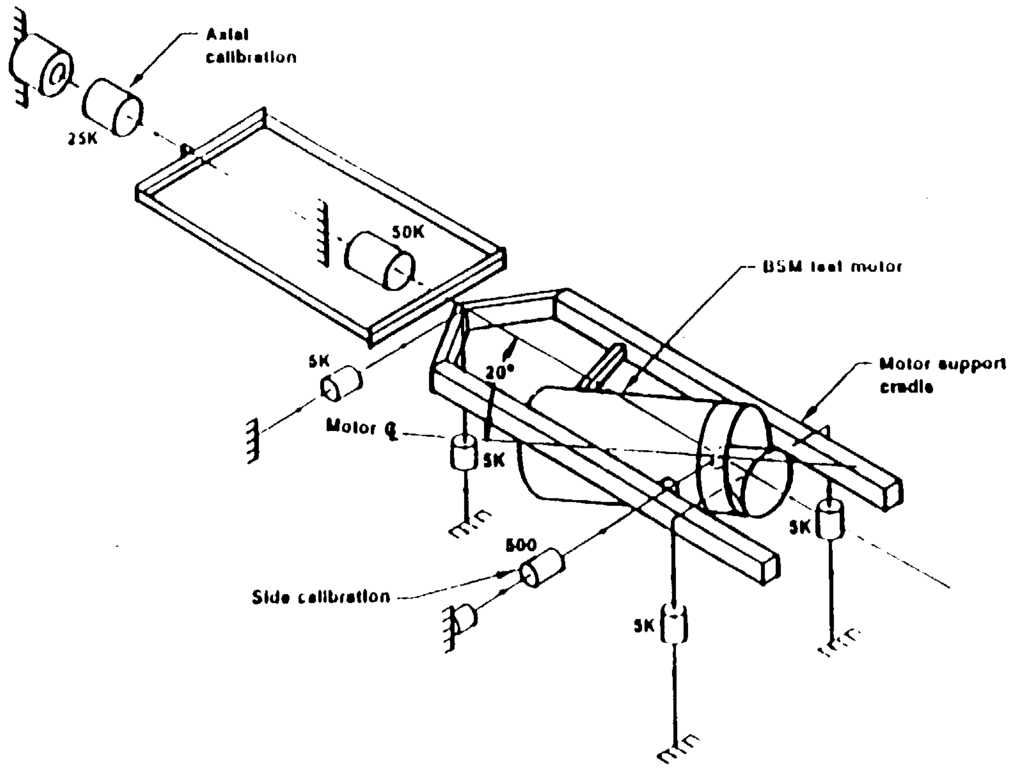
(f) Perform test stand calibration.

(g) Install motor in test stand.

(h) Verify that thrust vector (nozzle centerline) coincides with axial load cell centerline within ±1.25°.

(i) Record ambient conditions (pressure and temperature).

Figure 6.1-1 BSM THRUST MOUNT



6.3 PHOTOGRAPHIC COVERAGE

High-speed cameras (1000 fps) will be used to document the static firings and to detect potential failure modes or debris. At least two high-speed cameras will be mounted so that their lines of sight are parallel to and coincident with the nozzle exit plane. Field of view of these cameras should approximately 3 ft (across frame diagonal) at the nozzle exit plane.

At least two additional high-speed wide-field cameras will be deployed to observe overall plume behavior and to detect debris in the plume. Field of view should be approximately twelve feet in the plane of the plume. All high-speed cameras must be started sufficiently prior to the ignition signal (approximately 2 seconds) to ensure proper operation at ignition.

One or more wide-field low-speed (64 fps) cameras will be used for documentation. Run time will be from five seconds prior to ignition to a minimum of thirty seconds after burn out.

6.4 DATA REQUIREMENTS

The following data will be recorded during the static test:

(a) Chamber pressure (2)

(b) Nozzle centerline thrust and side force thrust

(c) Case wall temperature; 500° F maximum. Measurements will be taken before, during, and up to five minutes after test.

(d) Ignition voltage

(e) Ignition current

(f) High speed cameras

(g) Documentary cameras

(h) "Quick Look" plots

6.5 POST-TEST ACTIVITIES

Post-static test activities include the following:

(a) Post-fire measurements in accordance with SE0837, Table II (see figure 6.2-1).

(b) Post-fire still photographs of the nozzle, insulated aft closure, case, igniter, and fired motor.

(c) Digitally record the pressure, thrust, and temperature data at a sampling rate of 1000 samples per second (min). Time histories plots of pressure, thrust, and temperature are required. A digital tab run of each attribute versus time is required.

(d) Hardware will be inspected per the examination checklists in Appendix A. The aft closures will be subjected to post-test tap test, and edge unbond inspection. These results will mapped as shown in Appendix A and compared to pretest mapping to identify any bondline changes.

(e) The nozzle closures will be sectioned at the 0° - 180° line to determine post-test insulator thicknesses and compared to pre-test values to determine ablation rates.

(f) The Igniter assembly will be sectioned at a plane 90° from the alignment roll pin to verify designed performance of phenolic centering insert.

FIGURE 6.2-1

TABLE II

PRE AND POST-TEST MEASUREMENTS

Measurement	Azimuth	Pre-Test	Post-Test
Trimmed propellant weight, lb.		X	
Final assembly weight, lb.		X	X
Throat diameter, in. (four equally spaced measurements)	0° 45° 90° 135°	X X X X	X X X X
Exit diameter, in. (four equally spaced measurements	0° 45° 90° 135°	X X X X	X X X X
Barometric pressure, in. Hg		X	X
Relative Humidity		X	X
Ambient Temperature, °F		X	X
Closure Insulation Thickness	0°, 180°	X	X

Figure 6.2-2. STATIC TEST INSTRUMENTATION SUMMARY

ITEM	ID	INSTRUMENTATION	RANGE	LOCATION
Case Temperature	T1	Thermocouple	500°F	Motor Case
Thrust Axial Vertical Side		Load Cells	0-25 K lb 0-5 K lb 0-1 K lb	Thrust stand Thrust stand Thrust stand
Chamber Pressure	PC1 PC2	Pressure Transducers	0-3000 psi	Motor FWD Closure
Camera		High-speed (2 required)	1000 fps	Narrow field - line of sight parallel to exit plane
Camera		High-speed (2 required)	1000 fps	Wide field - line of sight in plane of plume
Camera		Documentary	64 fps	Provide overall coverage of motor and plume
Ignition Voltage			28 Volts	
Ignition Current			5-8 Amps	

APPENDIX A

A-1 BSM CLOSURE-TO-INSULATOR BOND MAP

1 ____________

2 ____________

3 ____________

4 ____________

5 ____________

6 ____________

FIGURE A-2 POST-TEST INSULATOR THICKNESS

RSM

POSTTEST HARDWARE EXAMINATION CHECK LIST

1) Motor Designation

a) Flight No ______

b) SRM ______

c) Fwd or Aft ______

d) Assembly Lot-Serial Number ______

e) MFR Number ______

f) Booster Assembly No. ______

g) Nozzle S/N ______

2) Motor Inspection (Before Disassembly)

a) Examine the exterior of the motor case. Are there any signs of bulges, discolorations, or signs of gas flow? YES NO

b) Examine the nozzle subassembly.

- Are there any discolorations or signs of gas flow external to the nozzle? YES NO
- Any unusual flow patterns on nozzle exit cone? YES NO
- Throat insert out of place? YES NO
- Throat insert condition abnormal? YES NO N/A (if not in place)

c) Examine the igniter assembly exterior. Is there any discolorations or signs of gas flow? YES NO

Describe in detail all items answered "YES". Have Photography record all unusual items.

EXAMINED BY: ______________ DATE ________

3) Aft Closure (After Disassembly)

(The design intent is for none of the following events to occur)

a) Examine the 2 O-ring seal areas of the aft closure. (Do not remove the O-rings at this time) Is there any evidence of gas leakage or O-ring char or ablation? Any evidence of O-ring groove or O-ring sealing surface damage

YES NO

b) Any evidence of thread damage?

YES NO

c) Any evidence of unusual ablation to aft closure insulation?

YES NO

Describe in detail all items answered "YES". Have Photography record ll unusual items.

EXAMINED BY: ____________ DATE ________

4) Motor Case Insulation

After disassembly of the motor, visually examine the motor case interior (using APPROPRIATE lighting and inspection equipment) Record the conditions listed below. (The design intent is for none of the following events to occur)

a) Examine the 2 O-ring seal areas at the igniter interface. Is there any evidence of gas leakage or O-ring char or ablation? YES NO

b) Examine the 2 O-ring seal areas at the closure interface. Is there any EVIDENCE of gas leakage, O-ring sealing surface damage or thread damage? YES NO

c) Is there any evidence of gas leakage thru the RTV insulation (Aft End)? YES NO

d) Are there any signs of irregular erosion? YES NO

Describe in detail all items answered "YES". Have Photography record all unusual items.

EXAMINED BY: ____________________ DATE ______

8) Igniter Assembly

(The design intent is for none of the following events to occur)

a) Examine the O-ring seal areas of the igniter. (Do not remove the O-ring at this time). Is there any evidence of gas leakage or O-ring char or ablation?

YES NO

b) Is there any discoloration, indication of excessive heating, or signs of gas flow?

YES NO

c) Did both initiators (TBIs) fire?

YES NO

Describe in detail all items answered "YES". Have Photography record all unusual items.

EXAMINED BY: ______________ DATE ______

This page intentionally left blank

Appendix D

SPECIFICATION SE0837 — MIX ACCEPTANCE TEST SPECIFICATION

CHEMICAL SYSTEMS DIVISION

UNITED TECHNOLOGIES

CODE IDENT NO.
14134

Specification No. SE0837
25 September 1978

SPECIFICATION

MIX ACCEPTANCE MOTOR TEST - BSM

Prepared by		Date
R.J. HALL	SPECIFICATIONS	9-22-78
Reviewed by	SPECIFICATIONS	9-25-78
Reviewed by	DESIGN ENGINEERING	9-25-78
Approved by	DESIGN ENG. SECTION CHIEF	9-25-78
Approved by	ENGINEERING MANAGEMENT	9-25-78
Approved by N/A	SYSTEMS DESIGN	9-25-78
Approved by N/A	MATERIALS & PROCESSES	9-25-78

Approved by		Date
	PROGRAM MANAGEMENT	9/25/78
Approved by	QUALITY ASSURANCE	9/25/78
Approved by	CONFIGURATION MANAGEMENT	9-25-78
Approved by	SAFETY	25 Sep 78
Approved by	DATA REDUCTION	25 Sep 78
Approved by		Date
Approved by		Date

ECA 47-180-9-25-78

Rev.	ECO No.	Prepared By	Approved by	Date

CSD 1312 (77/03)

PRECEDING PAGE BLANK NOT FILMED

CLASS II

CRBD 5180-00104

DRAWING/SPECIFICATION NO. SE0837 NC/1 | REV

ENGINEERING CHANGE ORDER

CHEMICAL SYSTEMS DIVISION UNITED TECHNOLOGIES

PROJ. NO. 5180 | E.C.O. 21576

14134
CODE IDENT NO.

SHEET 1 OF 2

TITLE
MIX ACCEPTANCE MOTOR TEST - BSM

PREPARED Congdon DATE 11-3-78	DESIGN ENGINEER 11/10/78	PROJECT MANAGER J.Rossen 11/10/78	
		PROJECT ENGINEER 11-10-78	QUALITY CONTROL 11/10/8
CHECKED DATE 11-9-78	ANALYSIS Grain S.a. 11/10/78	THOEIMAN	MATERIALS J.Hill 11/10/78
CHANGE CONTROL 11-14-78 F.F. Menefee	RELEASE FORM NO. B165-180	DATE 11-16-78	
	APPROVAL APPROVED/EN Bruffeath 11/14/78	APPROVAL	
SAFETY 11-13-78	FAST Gr. 30 J.Hill 11/13/78		

ITEM | PAGE NO. | PARA NO. | DESCRIPTION OF CHANGE

1.) 2 3.1.2.1 CHANGE: "3.1.2.1 IGNITION INTERVAL."
TO READ: "3.1.2.1 IGNITION INTERVAL (II)."
CHANGE: "..... SHALL BE $\leq$ 0.100 SEC."
TO READ: "..... SHALL BE $\geq$ .030 AND $\leq$ 0.100 SEC."

2.) 5 TABLE I CHANGE:

"WEB ACTION BURN TIME	3.1.1.3	4.2.3
MAXIMUM THRUST	3.1.1.4	4.2.3
WEB ACTION TIME AVERAGE THRUST	3.1.1.5	4.2.3
WEB ACTION TIME	3.1.1.6	4.2.3
TOTAL TIME	3.1.1.7	4.2.3"

REASON FOR CHANGE
SEE CRBD

DISPOSITION OF MATERIAL

CSO 0574 (78/09)

DRAWING/SPECIFICATION NO. SE0837	REV	ENGINEERING CHANGE ORDER	PROJ. NO. 5180	E.C.O. 21576
14134 CODE IDENT NO.		United Technology Center U A		SHEET 2 OF 2

ITEM	PAGE NO.	PARA NO.	DESCRIPTION OF CHANGE		
2) (CONT'D)			TO READ:		
			"MAXIMUM THRUST	3.1.1.3	4.2.3
			WEB ACTION TIME AVERAGE THRUST	3.1.1.4	4.2.3
			WEB ACTION TIME	3.1.1.5	4.2.3
			TOTAL TIME	3.1.1.6	4.2.3
			PRESSURE AT END OF WEB ACTION TIME	3.1.1.7	4.2.3
3.)	6	4.2.3	CHANGE: "....EACH OF THE ACCEPTANCE ....." TO READ: ".... EACH OF TWO ACCEPTANCE ....."		
4.)	6	4.2.3.2	UNDER 'STORAGE TEMPERATURE', CHANGE: "30°F 120°F" TO READ: "30°F ±5°F 120°F ±5°F"		

UTC-519A (12/62)

DRAWING/SPECIFICATION NO. SE0837 NC/2	REV	UNITED TECHNOLOGIES CHEMICAL SYSTEMS	ENGINEERING CHANGE ORDER	PROJ. NO. 5197	E.C.O. 27087
TITLE MIX ACCEPTANCE MOTOR TEST - BSM				14134 CODE IDENT NO.	SHEET 1 OF 1
PREPARED VSwinney DATE 9-17-83	DESIGN ENGINEER	PROJECT MANAGER R. Hough 9-20-83	CHANGE CONTROL 9-20-83	RELEASE FORM NO. 22259-180	DATE 9-22-83
CHECKED DATE 9-17-83	ANALYSIS	PROJECT ENGINEER 9-19-83	QUALITY CONTROL 9/19/83	APPROVAL	APPROVAL
		THERMAL 9-19-83	MATERIALS 9-19-83	SAFETY 9/19/83	9-19-83

ITEM	PAGE NO.	PARA NO.	DESCRIPTION OF CHANGE
1)	6	4.2.3.2	In first sentence, CHANGE "...configuration of 4.2.2.1 but..." to read: "... configuration of 4.2.3.1 but...

REASON FOR CHANGE SEE CRBD

DISPOSITION OF MATERIAL

CSD 0874 (78/09)

CLASS 1 CRBD

~~DRAWING~~/SPECIFICATION NO. SE0837 NC/3	REV	UNITED TECHNOLOGIES CHEMICAL SYSTEMS	ENGINEERING CHANGE ORDER	PROJ. NO. 5331	E.C.O. 28461
TITLE MIX ACCEPTANCE MOTOR TEST - BSM				14134 CODE IDENT NO.	SHEET 1 OF 1
PREPARED VSwinney DATE 12-28-83	DESIGN ENGINEER 1-3-84	PROJECT MANAGER 1-3-84 / PROJECT ENGINEER 1-3-84	DESIGN SURV. 1-3-84 / QUALITY CONTROL 1/3/84	CHANGE CONTROL / 1-3-84	RELEASE FORM NO. 22778-180 DATE 4-10-84
CHECKED DATE	ANALYSIS 1-3-84 R A JANKOWSKI	THERMAL 1-3-84	MATERIALS 1-3-83	SAFETY 1-3-84	APPROVAL S.E. 1/3/84 / APPROVAL

DESCRIPTION OF CHANGE

ITEM	PAGE NO.	PARA NO.	DESCRIPTION OF CHANGE
1)	1	1.0	REMOVE the following End Item configurations: " B12000-02-01 " and " B12000-04-01 "
2)	1	1.0	CHANGE " ... NASA for delivery. " TO " ... USBI for delivery. "
3)	1	2.0	CHANGE " National Aeronautics and Space Administration 10A00461 Confined ... " TO " United Space Boosters Inc. 10308-0003-801 Confined ... "
4)	4	Figure 1	In note 1 of Figure, CHANGE " ... defined by MSFC drawing 10A00461. " TO " ... defined by USBI drawing 10308-0003-801. "

REASON FOR CHANGE

SEE CRBD

DISPOSITION OF MATERIAL

CLASS 11 CRBD

DRAWING/SPECIFICATION NO.	REV	UNITED TECHNOLOGIES CHEMICAL SYSTEMS	ENGINEERING CHANGE ORDER	PROJ. NO.	E.C.O. 30971
SE0837 NC/4				5174	
TITLE MIX ACCEPTANCE MOTOR TEST - BSM				14134 CODE IDENT NO.	SHEET 1 OF 2
		PROJECT MANAGER 8/12/85	DESIGN SUP 8/12/85	CHANGE CONTROL	RELEASE FORM NO. 24740-100- DATE 8-23-85
PREPARED A. Wilson DATE 5Aug85	DESIGN ENGINEER 8/8/85	PROJECT ENGINEER 8-8-85	QUALITY CONTROL 8/13/85	8/13/85	APPROVAL / APPROVAL
CHECKED DATE	ANALYSIS 8/13/85	8-13-85	MATERIALS 8-8-85	SAFETY W Warwick 8/13/85	

DESCRIPTION OF CHANGE

ITEM	PAGE NO.	PARA NO.	
1	1	1.0	REVISE in entirety to read:

"1.0 SCOPE

1.1 Scope. This specification establishes the requirements for acceptance test firing of two motors selected from each propellant mix used to manufacture any of the following Contract End Item (CEI) SC0726A configuration B12000-XX-XX.

Successful completion of the verifications defined herein is a prerequisite for submittal of the remaining mix CEIs to USBI for delivery."

2 1 2.0 CHANGE Specifications heading and entry under heading from:

"Specifications

None"

to: "Specifications

SE1154 Aeroheat Shield Cover, Lot Acceptance Test, Requirements for - Booster Separation Motor"

3 3 Figure 1 CHANGE face of drawing from: "ROCKET MOTOR ASSEMBLY-SHIPPING CONFIGURATION B12000-01-01" to: "ROCKET MOTOR ASSEMBLY-SHIPPING CONFIGURATION B12000-XX-XX"

REASON FOR CHANGE

DISPOSITION OF MATERIAL

CSD 0574 (78/09)

~~DRAWING~~/SPECIFICATION NO. SE0837	REV	UNITED TECHNOLOGIES CHEMICAL SYSTEMS	ENGINEERING CHANGE ORDER	PROJ. NO. 5174	E.C.O. 30971
14134 CODE IDENT NO.					SHEET 2 OF 2

DESCRIPTION OF CHANGE

ITEM	PAGE NO.	PARA NO.	DESCRIPTION OF CHANGE
4	4	Note 2	CHANGE from: "...port plug (item 21 of PLB12000-01-01) and..." to: "...port plug and..."
5	4	Note 4	REVISE in entirety: "The B12879-02-01 cover seal may be omitted. The B12099-01-01 weather seal shall be removed prior to the temperature conditioning of 4.2.3.2."
6	4	Note 5 (NEW)	ADD new Note 5: "When the Aeroheat Shield Lot Acceptance Test is combined with the Mix Acceptance Motor Test, specification SE1154 is applicable."
7	4	Note 6 (NEW)	ADD new Note 6: "When the aft motor configuration is to be used for the Mix Acceptance Motor Test, the insulation cork may be omitted or modified as required to eliminate interference with the test stand."

DWR

DOCUMENT NO.	REV	UNITED TECHNOLOGIES CHEMICAL SYSTEMS	CLASS II	CONTROL NO. 5594-00137
SE0837	NC/5	ENGINEERING CHANGE ORDER	PROJ. NO. 5594	ECO NO. 39497
DOCUMENT TITLE: MIX ACCEPTANCE MOTOR TEST BSM		FSCM 14134	CHANGE TYPE: [X] ORDER [ ] DCN	SHEET 1 OF 1

PREPARED / DATE	DESIGN ENGINEER	PROGRAM MANAGER	ENG.-CHG. CONTROL	CONFIG. MGT.	RELEASE GROUP	DATE
L. WEINSTEIN 6/21	6-27-90	7-11-90	7/11/90			5/10/91

CHECKED / DATE	ANALYSIS	PROJECT ENGINEER	PRODUCT ASSURANCE	OPERATIONS	O. P. C.	CUST.
6/22/90	N/A 6-27-90	6-27-90	7-11-90	7/11/90	N/A 6-27-90	BON-131-7/11/90

	MATERIALS	SAFETY	THERMAL	E. S. D.
	N/A 6-27-90	7-11-90	6-27-90	N/A 6-27-90

ITEM	PAGE NO.	PARA NO.	DESCRIPTION OF CHANGE
1)	6	4.2.3.2.1	ADD new Paragraph in its entirety:

" 4.2.3.2.1 Reconditioning of motor. The 24 hour conditioning period starts after the chamber's average air temperature stabilizes. Should the motor be out of conditioning for greater than 30 minutes it must be reconditioned at the ratio of 2:1, e.g.,recondition 2 hours for every hour out of conditioning.

REASON FOR CHANGE

SEE CHANGE REQUEST (Design Change)

EFFECTIVITY: [ ]

E.C.P. NO.

COMPUTER DATA BASE:
CHANGED BY: VERIFIED BY:

DWR 2698 CLASS II CONTROL NO. 5594-0012?

DOCUMENT NO.	REV		PROJ. NO.	ECO NO.
SE0837 NC/6		UNITED TECHNOLOGIES CHEMICAL SYSTEMS — ENGINEERING CHANGE ORDER — FSCM 14134	5596	38773

DOCUMENT TITLE: MIX ACCEPTANCE MOTOR TEST - BSM

CHANGE TYPE: ☒ ORDER ☐ DCN — SHEET 1 OF 1

PREPARED / DATE	DESIGN ENGINEER	PROGRAM MANAGER	ENG. CHG. CONTROL	CONFIG. MGT.	RELEASE GROUP / DATE
BYERS 12/1/89	2/14/90	V. Ollo... 3-9-90	3/9/90	3/14/90	7/11/91

CHECKED / DATE	ANALYSIS	PROJECT ENGINEER	PRODUCT ASSURANCE	OPERATIONS	O.P.C.	CUST. ~~GOVT.~~
2/14/90	N/A	2/20/90	3-9-90	3/6/90	N/A	BDN-053-90/HSV 2/8/90
		MATERIALS N/A	SAFETY 3/8/90	THERMAL N/A	E.S.D. 2/19/90	

ITEM	PAGE NO.	PARA NO.	DESCRIPTION OF CHANGE
1)	1	2.0	ADD the following under Specifications: "MIL-G-4343 Grease, Pneumatic System"
2)	4	Figure 1 Note 1	DELETE Note 1 in its entirety and replace with new Note 1 as follows: "CDF initiator interfaces (2) are defined by USBI Drawing 10308-0003-801. Use CDF assembly P/N series 10314-0001-XXX. If using a CDF assembly with incompatible key, file 1 key off the end of CDF assembly, while grounded, to accommodate key way of motor CDF initiator. Use blasting cap No. 6 or No. 8. Butt-up blasting cap against cut end of CDF assembly. Tape the two components together."
3)	4	Figure 1 Note 2	DELETE Note 2 in its entirety and replace with new Note 2 as follows: "Remove the transducer port plug and install an AN815-4J, 4K or 4S union with one AS568A-904 O-ring into the port. Lubricate the O-ring with MIL-G-4343 prior to installation. Torque union to 50- to 60-inch pounds. The pressure transducers (Items 1 and 2 of Appendix A) shall be plumbed to the union using one-quarter inch stainless steel tubing and fittings."
4)	2	3.3	ADD new Paragraph 3.3 as follows: "Safety. This item is ESD sensitive and appropriate safety precautions should be exercised when handling or processing."

REASON FOR CHANGE: SEE CHANGE REQUEST (Manufacturing Request)

EFFECTIVITY: ☐ ______ ☒ SET BY OPERATIONS (8/14/91)

E.C.P. NO.

COMPUTER DATA BASE: CHANGED BY: ______ VERIFIED BY: ______

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

CAGE CODE 14134

ENGINEERING CHANGE ORDER

DOCUMENT TITLE	DOCUMENT NO.	REVISION OLD	REVISION NEW
Mix Acceptance Motor Test - BSM	SE0837	NC/6	NC/7

TYPE	CLASS	CONTROL NO.	PROJ NO	SHEET
☒ ECO ☐ DCN	II	5594-00158	5594	1 OF 1

DESCRIPTION OF CHANGE

SEE CHANGE REQUSET (Customer Request)

A ☒ INCORPORATE INTO DOCUMENT B ☐ REWORK INSTRUCTIONS

ITEM	PAGE	PARAGRAPH	DESCRIPTION
1	2	3.1.1.5	CHANGE as follows: WAS: "The web action time ... 0.800 sec." IS: "The web action time ... 0.805 sec."
2	2	3.1.1.8 (NEW)	ADD the following: "3.1.1.8 Maximum Expected Operating Pressure (MEOP). The maximum expected operating pressure shall be 2220 PSIA."

MATERIAL DISPOSITION

NOTE: INDICATE DISPOSITION BY "✓". QTY COLUMN IS FOR MATL CONTROL ONLY.

	QTY	USE AS IS	REWORK	SCRAP	NO EFFECT	SEE NOTE
ON ORDER					✓	
IN STOCK					✓	
IN PROCESS					✓	
IN FINISHED GOODS					✓	
SHIPPED UNITS					✓	

ADDITIONAL NOTES

NEXT ASSY: SE0727

EFFECTIVITY:
☐
☒ SET BY OPN (3/15/92 & LATER)

APPROVAL

		DATE
PREPARED BY	R.S.NAYLOR	2/26/90
CHECKED	S.Weinstein	3/1/91
DESIGN, ENGR	[signature]	3/5/91
		DATE
		DATE
CONFIG RELEASE	CM 12	2-27-92

SPECIFICATION

MIX ACCEPTANCE MOTOR TEST - BSM

1.0 SCOPE. This specification establishes the requirements for acceptance test firing of two motors selected from each propellant mix used to manufacture any of the following Contract End Item (CEI) SC0726A configurations:

B12000-01-01
B12000-02-01
B12000-03-01
B12000-04-01

Successful completion of the verifications defined herein is a prerequisite for submittal of the remaining mix CEIs to NASA for delivery.

2.0 APPLICABLE DOCUMENTS. The following documents form a part of this specification to the extent specified herein. In the event of conflict between documents referenced here and other detailed content of sections 3, 4, 5, 6 and Appendix A, the detail requirements shall be considered a superseding requirement.

Specifications

None

Drawings

Chemical Systems Division (CSD)

B12000	Rocket Motor Assembly - Shipping Configuration
B12018	Case and Aft Closure/Nozzle Shell Assembly
B12879	Seal, Cover

National Aeronautics and Space Administration

10A00461	Confined Detonating Fuse Initiator for Space Shuttle Solid Rocket Booster

3.0 REQUIREMENTS

3.1 Performance. Performance requirements necessary for demonstration of CEI mix lot acceptability are listed in this section.

3.1.1 Propulsion. Each acceptance test motor shall demonstrate performance which meets the following requirements.

3.1.1.1 Web Action Time Total Impulse (ITWAT). The web action time total impulse (6.1.17) shall be ≥ 14,000 lb-sec.

3.1.1.2 Action Time Total Impulse (ITAT). The action time impulse (6.1.18) shall be ≥ 15,000 lb-sec.

3.1.1.3 Maximum Thrust (FMAX). The maximum thrust (6.1.16) shall be ≤ 29,000 lb.

3.1.1.4 Web Action Time Average Thrust (TAWAT). The web action time average thrust (6.1.19) shall be ≥ 18,500 lb.

3.1.1.5 Web Action Time (WAT). The web action time (6.1.19) shall be ≤ 0.800 sec.

3.1.1.6 Total Time (TT). Total time (6.1.12) shall be ≤ 1.050 sec.

3.1.1.7 Pressure at End of Web Action Time (PCEWAT). Pressure at end of web action time (6.1.14) shall be ≤ 2,000 psia.

3.1.2 Ignition. Each acceptance test motor shall demonstrate performance which meets the following requirements.

3.1.2.1 Ignition Interval. The ignition interval (6.1.13) shall be ≤ 0.100 sec.

3.2 Test Configuration.

3.2.1 Test Configuration Drawings. The configuration of the contract end item of section 1 as assembled for the testing described herein shall be in accordance with figure 1 and drawings referenced thereon.

3.2.2 Test Equipment Requirements. The configuration of the test equipment used in performing the tests described herein shall be as follows.

3.2.2.1 Static Test Stand. A static test stand, capable of restraining the test configuration of 3.2.1 according to the requirements of figure 1, note 3 while measuring nozzle centerline thrust to the requirements of items 4 and 5 of Appendix A is required. In place, thrust calibration capability is required.

3.2.2.2 Data System. A data system capable of recording the data of, and meeting the requirements specified by, Appendix A is required.

3.2.2.3 Ordnance Initiation System. An ordnance control system to simultaneously initiate the TBIs of figure 1, note 1 is required.

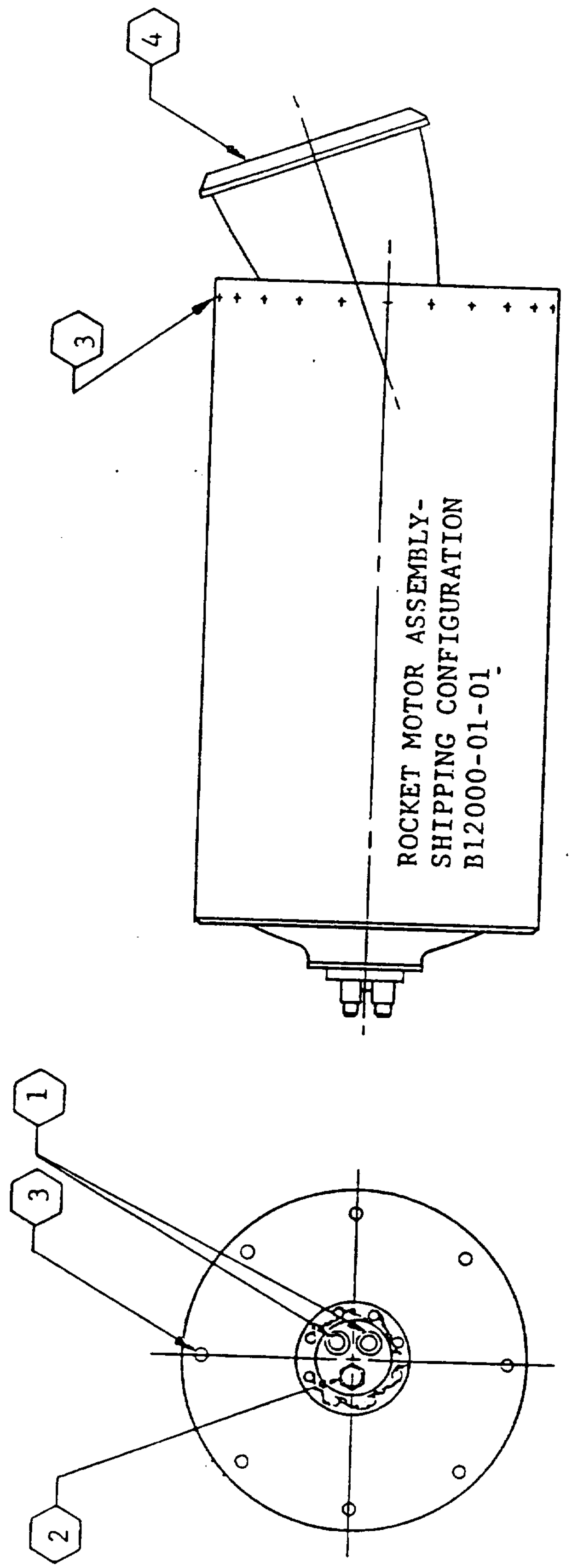


FIGURE 1 TEST CONFIGURATION (SHEET 1 OF 2)

1. TBI interfaces (2) are defined by MSFC drawing 10A00461.

2. Remove the B13348-01-01 transducer port plug (item 21 of PLB12000-01-01) and install the pressure transducers required by items 1 and 2 (Appendix A). The transducer end fitting shall be a MS33656-E4 using 1 each 3-904 and 2-019 O-rings. Lubricate the O-rings using MIL-G-4343 prior to installation. Torque transducer to 325 to 375 in-lb.

3. The motor/test stand attachment interface shall be the 8 forward threaded inserts as defined on B12018 and an aft split compression ring. Forward attachment fasteners shall be torqued to 325 in-lb maximum. Compression ring bolts shall be torqued to 425 in-lb maximum.

4. The B12879-01-01 cover seal (item 28 of B12000-01-01) may be omitted. The B12099-01-01 weather seal (item 27 of B12000-01-01) shall be removed prior to the temperature conditioning of 4.2.3.2.

FIGURE 1. TEST CONFIGURATION
(SHEET 2 OF 2)

TABLE I.

VERIFICATION CROSS REFERENCE INDEX

Section 3 Requirement Paragraph Title	Requirement Paragraph Number	Section 4 Verification Paragraph
Web Action Time Total Impulse	3.1.1.1	4.2.3
Action Time Total Impulse	3.1.1.2	4.2.3
Web Action Burn Time	3.1.1.3	4.2.3
Maximum Thrust	3.1.1.4	4.2.3
Web Action Time Average Thrust	3.1.1.5	4.2.3
Web Action Time	3.1.1.6	4.2.3
Total Time	3.1.1.7	4.2.3
Ignition Interval	3.1.2.1	4.2.3

4.0 QUALITY ASSURANCE

4.1 Product Performance Requirement/Quality Verification Cross Reference Index. All tests/verifications included herein shall be identified as mix acceptance test verifications. All tests/verifications included herein shall be conducted to the verification methods indicated in table I and as described hereinafter. The equipment used in the performance of the tests specified herein shall be within the calibration requirements of that equipment.

4.2 Tests/Verifications.

4.2.1 Drawing Compliance. The CEI in test configuration shall be inspected to determine conformance to 3.2.1.

4.2.2 Pre-test Measurements. The measurements required by table II shall be taken and recorded.

4.2.3 Static Tests. The static tests shall consist of separate simulated flight functional tests of each of the acceptance motors wherein the motors shall be ignited and burned. Data will be time recorded, digitized and computer reduced and accepted.

4.2.3.1 Configuration. Each motor will be prepared as in figure 1 and assembled to the test equipment of section 3.2.2.

4.2.3.2 Test Temperature. Prior to establishing the configuration of 4.2.2.1 but after meeting the requirements of figure 1, note 2 , the test motors shall be temperature conditioned as follows:

Motor	Storage Temperature	Min. Duration at Storage Temperature	Maximum Time From Storage Until Static Test
1	$30^{o}F$	24 hours	30 minutes
2	$120^{o}F$	24 hours	30 minutes

4.2.3.3 Ambient Test Conditions. The motors shall be fired in an ambient temperature and pressure environment.

4.2.3.4 Instrumentation. Measurements, as required by Appendix A, shall be recorded.

4.2.3.5 Sequence.

4.2.3.5.1 Instrumentation Recording. The instrumentation of section 4.2.3.4 shall be recorded for a minimum of 1 second prior to issuance of the motor ignition command and for a minimum of 5 seconds after issuance of the motor ignition command.

TABLE II

PRE AND POST TEST MEASUREMENTS

		Pre-Test	Post-Test
Trimmed propellant weight, lb.		X	
Final assembly weight, lb.		X	X
Throat diameter, in. (four equally spaced measurements)	0°	X	X
	45°	X	X
	90°	X	X
	135°	X	X
Exit diameter, in. (four equally spaced measurements)	0°	X	X
	45°	X	X
	90°	X	X
	135°	X	X
Barometric pressure, in. Hg		X	X
Relative Humidity, %		X	X
Ambient Temperature, $^\circ$F		X	X

4.2.4 Post Test Measurements. The measurements required by table II shall be taken and recorded.

5.0 PREPARATION FOR DELIVERY

Not applicable.

6.0 NOTES

6.1 Definitions.

6.1.1 Chamber Pressure. Chamber pressure (PC) is defined as the recorded measurements required by Appendix A, items 1 and 2. PC may be either measurement or the algebraic average of both.

6.1.2 Ignition Command. Ignition Command (IC) is defined by either one of two alternative methods:

a) The first detectable increase above zero in the recorded measurement required by Appendix A, item 3.

b) The first detectable increase above zero in the recorded measurement required by Appendix A, item 8.

6.1.3 Ignition Time. Ignition time (IT) is the time at ignition command (IC). It is also defined as time equal to zero for data reporting (figure 2).

6.1.4 Nozzle Centerline Thrust. Nozzle centerline thrust (FX) is defined as the corrected recorded measurements required by Appendix A, items 4 and 5. FX may be either measurement or the algebraic average of both. Algebraic correction by the recorded measurements required by Appendix A, items 6 and 7 shall be performed in order to quantify FX.

6.1.5 PC-Time Trace. The PC-time trace (PCTT) is defined as the cross plot between PC and time (figure 2).

6.1.6 Initial Maximum Chamber Pressure. Initial maximum chamber pressure (PCMAX) is defined as the first maximum of PC (figure 2).

6.1.7 Beginning of Web Action Time. Beginning of web action time (BWAT) is defined as that time on the PCTT at which PC has reached 75 percent of PCMAX (figure 2).

6.1.7 End of Web Action Time. End of web action time (EWAT) is defined by the following geometric construction (reference figure 2).

(1) Extend the general shape of the PCTT prior to and immediately after the beginning of tailoff.

(2) Bisect the angle formed by these extensions.

(3) Extend the bisector to intersect the PCTT.

(4) EWAT is the time corresponding to the intersection of (3) above.

6.1.9 Web Action Time. Web Action Time (WAT) is defined as the time interval from BWAT to EWAT (figure 2).

6.1.10 End of Action Time. End of action time (EAT) is defined as that time at which PC has decayed to a value equivalent to 10 percent of PCMAX (figure 2).

6.1.11 Action Time. Action time (AT) is defined as the time interval from BWAT to EAT (figure 2).

6.1.12 Total Time. Total time (TT) is defined as the time interval from IT to the time at which PC has decayed to a value equivalent to 50 percent of PCEWAT (6.14) (figure 2).

6.1.13 Ignition Interval. Ignition interval (II) is defined as the time interval from IC to BWAT (figure 2).

6.1.14 Pressure at End of Web Action Time. Pressure at the end of web action time (PCEWAT) is defined as the value of PC at EWAT (figure 2).

6.1.15 Corrected Vacuum Thrust. Corrected vacuum thrust (CVT) is defined as FX adjusted from ambient test pressure to vacuum.

6.1.16 Maximum Thrust. Maximum thrust (FMAX) is defined as the maximum observed CVT.

6.1.17 Web Action Time Total Impulse. Web action time total impulse (ITWAT) is defined as:

$$ITWAT = \sum_{t = BWAT}^{EWAT} (CVT) \Delta T$$

where: ΔT = data sampling interval

6.1.18 Action Time Total Impulse. Action time total impulse (ITAT) is defined as:

$$ITAT = \sum_{t = BWAT}^{EAT} (CVT) \Delta T$$

where: ΔT = data sampling interval

6.1.19 Web Action Time Average Thrust. Web action time average thrust (TAWAT) is defined as:

$$TAWAT = \frac{ITWAT}{WAT}$$

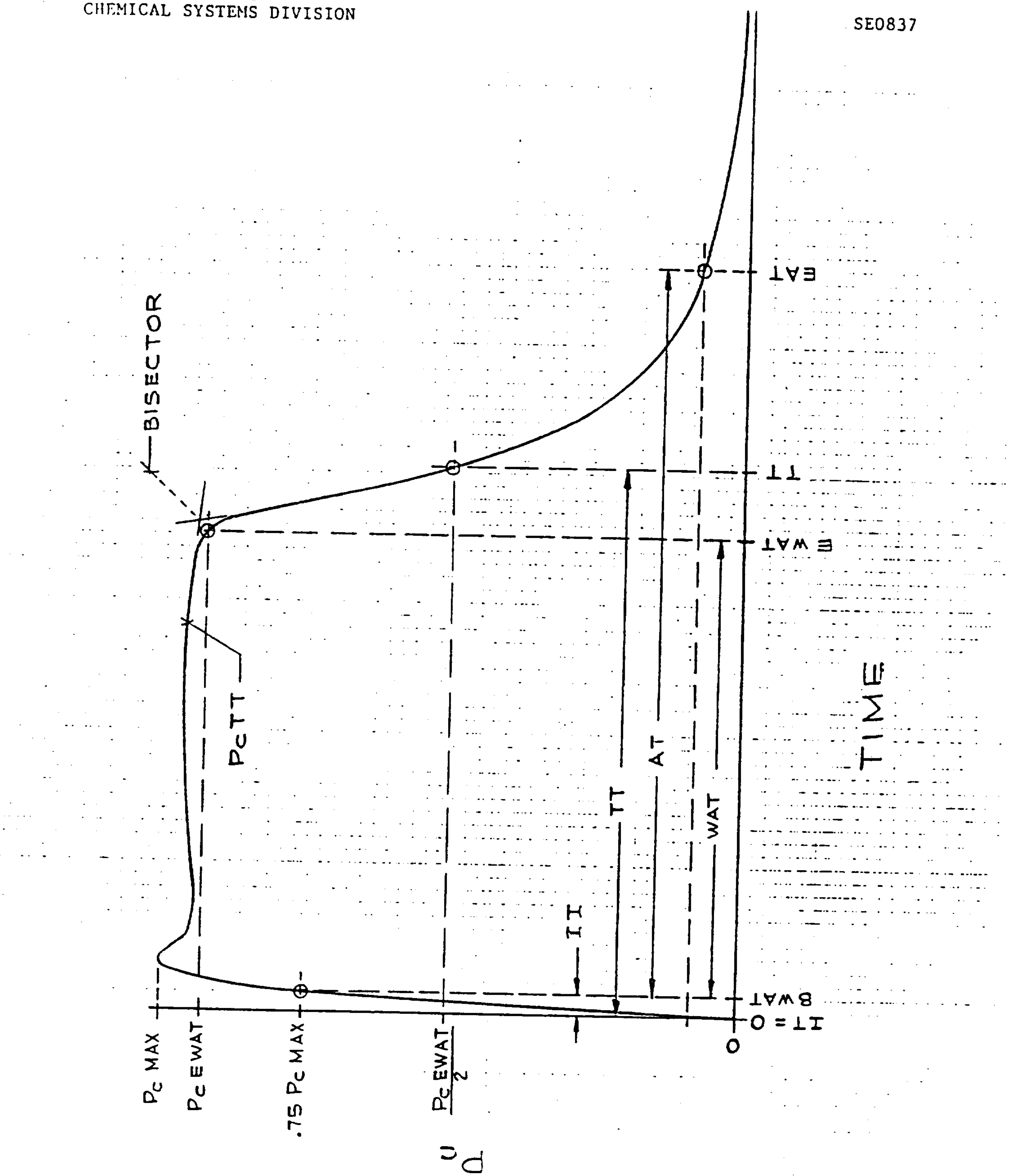


FIGURE 2. DEFINITIONS

APPENDIX A

INSTRUMENTATION REQUIREMENTS

INSTRUMENTATION LIST

Item	Symbol	Parameter	Maximum Range	Hertz Response	Location ⚠1
1	PC1	Head End Motor Chamber Pressure No. 1	3000 psig	100	2
2	PC2	Head End Motor Chamber Pressure No. 2	3000 psig	100	2
3	IS	Ignition Current	15 amp	1000	1
4	FXA	Nozzle Centerline Thrust A	100 K lbs	100	Facility
5	FXB	Nozzle Centerline Thrust B	100 K lbs	100	Facility
6	FCXA	Test Stand Calibration Force A	50 K lbs	100	Facility
7	FCXB	Test Stand Calibration Force B	50 K lbs	100	Facility
8	EI	Ignition Voltage	28 vdc	1000	1

⚠1 reference figure 1 for BSM motor interface references.

This page intentionally left blank

NASA—MSFC—C